THE OHIO JOURNAL OF SCIENCE

VOL. LI JULY, 1951 No. 4

DISTRIBUTION OF OHIO ANIMALS[1]

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Ohio has a very rich and diversified fauna, as might be expected, in view of the wide range of habitats fringing the glacial boundary. This large complex of species has diverse sources of origin and represents migrations during a number of periods from the Tertiary to the present.

The various elements may be roughly listed as follows: (1) Alleghany Plateau species, (2) boreal relicts, (3) invaders from the Atlantic seaboard, (4) immigrants from south and southwest of the glacial boundary, (5) invaders from the west during the Xerothermic Period, and (6) species which have extended their range as a result of occupation of the land by Europeans. This classification is undoubtedly over-simplified.

The study of the distribution of organisms is by no means a simple matter. Biogeography is admittedly still in its infancy. The climatic regimes of even so short and so recent a period as post Wisconsin time have been subject to violent fluctuation. Deevey (1949, p. 1356) lists five climatic periods since the retreat of the ice, based upon the analysis of fossil pollen in bogs: (1) a cool period, characterized by spruce and fir pollen (2) warmer and dry, with pine pollen conspicuous (3) warm (and moist) with a predominance of beech and hemlock (4) warm and dry, with a maximum of oak and hickory, a period often called the Xerothermic, and (5) the present, cooler and moister, with spruce returning in some northern states.

The Alleghany Plateau fauna contains many species of ancient origin. Transeau (1941, p. 210), Braun (1951), Wolfe (1951) and other students have expressed the opinion that certain elements of the preglacial forests may have existed throughout the Pleistocene in the Plateau within a short distance from the glacial boundary. If such is the case, and I am sympathetic with this viewpoint, it would seem to follow that some of the Pliocene animals were also present throughout the Ice Age.

Biologists are not in agreement on this point. The most extreme view to the contrary is that of Deevey (1949, p. 1375) who, after a very extensive survey of the biogeography of the Pleistocene, comes to the conclusion that glacial chilling must have been so extensive that warmth-loving species of plants and animals could have survived only in peninsular Florida and in Mexico. Potzger (1951) has summarized the evidence of northern plants and animals in the southeastern states during the Pleistocene: spruce pollen has been reported from Texas, Louisiana, Florida and North Carolina; remains of Musk-ox, a species now known only from the Arctic,

[1]Presidential address at the annual meeting of The Ohio Academy of Science at Miami University, Oxford, Ohio, on April 5, 1951. It is somewhat modified and expanded from a paper, "Animal Distribution in Relation to the Glacial Boundary" which was part of a symposium on "The Glacial Border" presented before The Ecological Society of America at Columbus, Ohio, on September 13, 1950.

have been recorded from Mississippi and Oklahoma, while the woolly mammoth has been reported from Texas and Florida.

Some of these records may very likely be fossil flotsam, as Wolfe (1951) has suggested. Others of the reports are from the coastal plain. As Braun (1950,

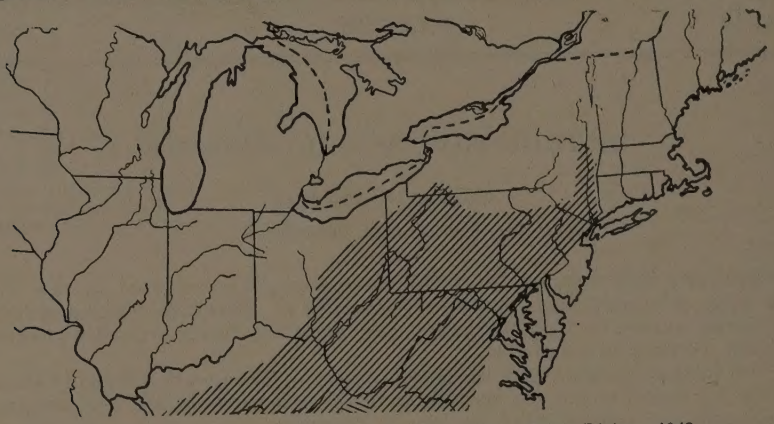

FIGURE 1. Distribution of the red salamander. From Bishop, 1943.

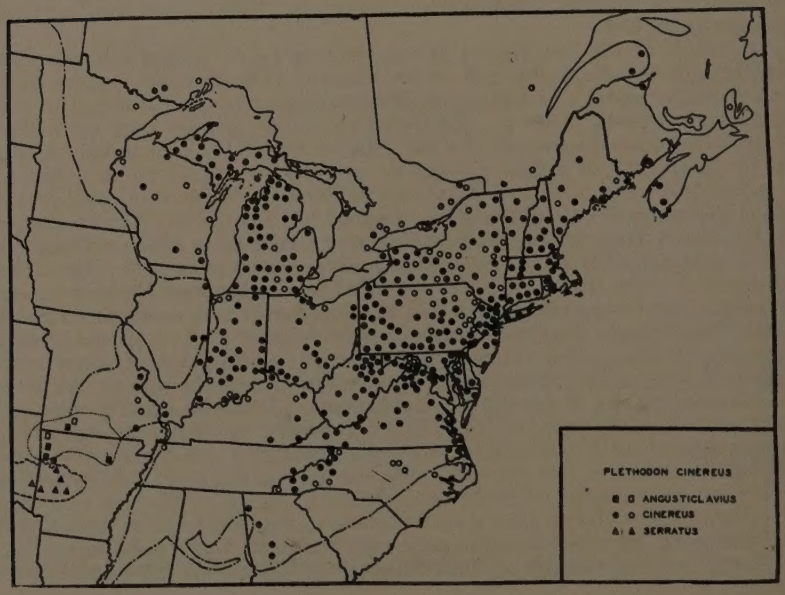

FIGURE 2. Distribution of the red-backed salamander. From Grobman, 1944.

p. 513) indicates, during the maximum of the Wisconsin, the level of the ocean was lowered by many feet, exposing vast areas of coastal terraces. These, and the extensive fluviatile deposits in consequence of the tremendous floods of glacial

water, may well have been occupied temporarily by coniferous forests and boreal bogs and the northern animals associated with them.

But even if we should concede that many northern plants and animals were able to penetrate far into the southeastern states during the Pleistocene, I do not believe that the converse necessarily follows, namely that many of the so-called southern animals could not have survived close to the glacial border. Granting the potent ability of many organisms to extend their ranges rapidly for great distances, nevertheless there are many other species which I can not believe were capable of migrating in a few thousands of years from Ohio to Florida or Mexico and back again. While it is perfectly true that an animal may have legs and perhaps wings and hence be physically capable of rapid and extensive migration, it is also

FIGURE 3. Distribution of the *Melanoplus mancus* group of grasshoppers. Solid circles, *M. islandicus;* open circles, *M. mancus;* solid squares, *M. celatus;* open squares, *M. divergens;* "X," *M. serrulatus*. Heavy line indicates Wisconsin boundary.

an axiom that an animal can not successfully extend its range beyond its suitable habitat and to that extent can expand into new territory no more rapidly than a plant. Both must await suitable ecological conditions before moving into them.

It is freely conceded that our knowledge is still fragmentary on the subject. Clarification must await much more evidence than we now possess. It is freely conceded, as Dr. Deevey observes, that the present range of an animal does not indicate that it has always been there. Nevertheless, the distribution patterns and the ecological requirements of many animals in the middle west seem to me to indicate that they survived the Wisconsin glaciation close to the glacial boundary. I believe that this is true, not only in the unglaciated Plateau, but also *within glaciated territory*. A number of examples will be offered in support of this opinion as we proceed.

A great many Plateau species have been unable to extend their range into glaciated territory, while others have spread widely to the north and west. This is strikingly illustrated by the Plethodont salamanders. This family of lungless

salamanders is of ancient origin, having originated, Dunn (1926) believes, in the Southern Blue Ridge mountains, from which center the family has dispersed widely throughout the United States. Some of the more northern of the Plateau species are still closely confined to the unglaciated Plateau, such as *Plethodon wehrlei*, the Green Salamander, *Aneides aeneus*, and the Red Salamander, *Pseudotriton ruber* (fig. 1). As contrasted with these, the Red-backed Salamander, *Plethodon cinereus*, has extended its range as far north as Minnesota and New Brunswick, possibly as far north as Hudson's Bay (fig. 2). Grobman (1944) estimates that this small salamander may in its spread have averaged as much as 1 mile every 37 years since the time of the Cary substage of the Wisconsin glaciation. He points out, however, that in the event that Cape Breton Island and the Gaspe Peninsula

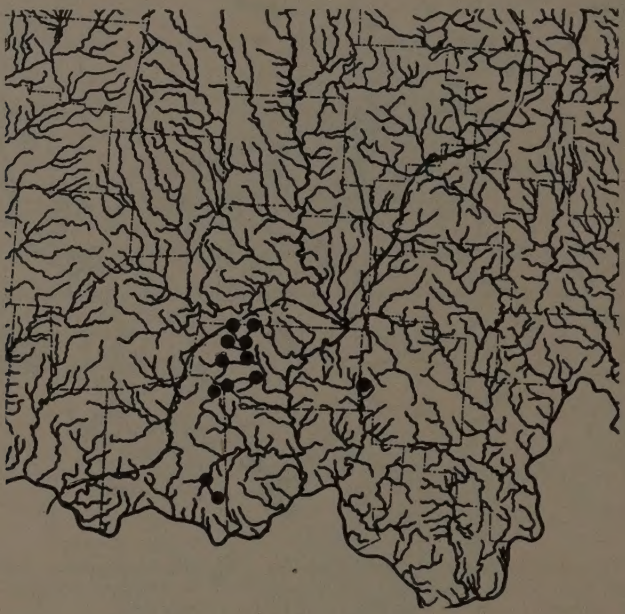

FIGURE 4. Ohio distribution of the minnow, *Clinostomus vandoisulus*. (M. B. Trautman, ms.)

were not glaciated by the Wisconsin ice, these areas, along with the driftless area of Wisconsin might well have been auxiliary dispersal centers, in which event the speed of dispersal would have been considerably less. On the other hand, recent Carbon 14 findings indicate a much shorter period since Cary time than was previously believed, which would increase the assumed speed of dispersal. It seems probable that a westward dispersal of *cinereus* from its original home in the Plateau took place prior to the Wisconsin glaciation, and that during Wisconsin time it survived over a wide area along the southern periphery of the ice front, whence it quickly returned to the north following the retreat of the ice.

The grasshoppers of the Mancus group of the genus *Melanophus* present a distributional picture which is strikingly similar (fig. 3). These short-winged (and hence flightless) grasshoppers are known only from the eastern United States, three species being confined to the southern portion of the Appalachian Highland. One species, *Melanoplus mancus*, is restricted to the northern portions of the

mountains, from which it has spread a short distance into glaciated territory. The fifth species, *Melanoplus islandicus*, has spread widely to the northwest. *Islandicus* thus has a pattern in the middle west similar to *Plethodon cinereus*. It is my belief that it had dispersed widely from its place of origin in the Plateau prior to Wisconsin times. The Wisconsin ice sheet may have all but exterminated the species, but small populations in one or more refugia enabled it to repopulate a large area of glaciated country after the retreat of the ice. The distribution of *mancus* also indicates to me that this species survived the Wisconsin not far south of the boundary.

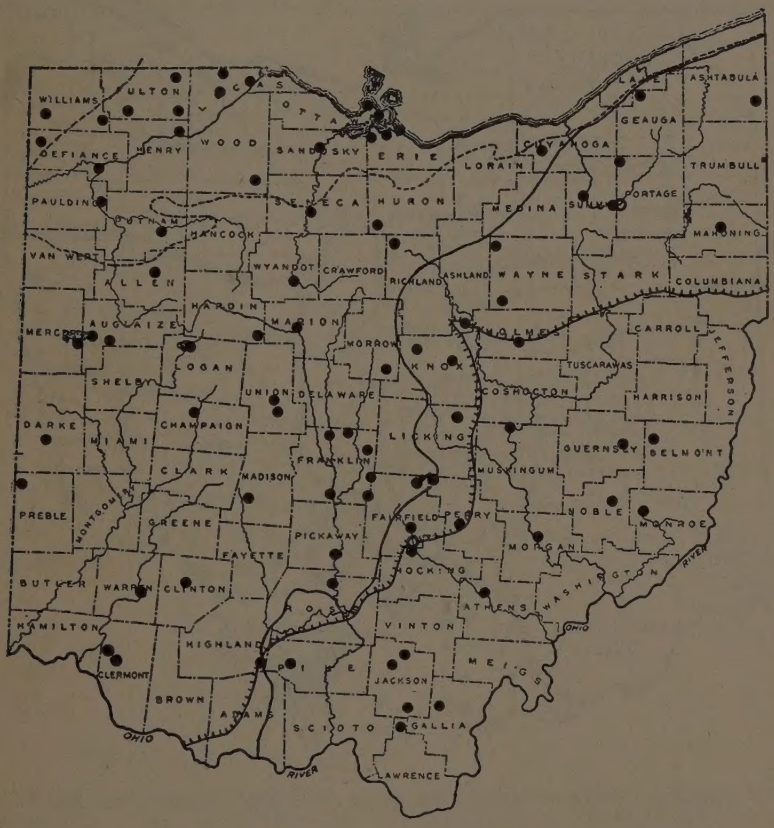

FIGURE 5. Ohio distribution of the striped chorus-frog. From Walker, 1946.

Another example of a southern species which has not been able to invade glaciated territory is presented by the Rosy Dace, *Clinostomus vandoisulus* (fig. 4). In Ohio, this handsome, little minnow is restricted to the headwaters of a few small tributaries of the preglacial Teays river system.

I agree with Milton Trautman (1951) that the distribution of *vandoisulus* suggests a relict population of long residence, probably since preglacial times. The Ohio River, which came into existence when an early glacier blocked the path

of the northward-flowing Teays, would seem to be an effective barrier to the spread of this minnow. It is a fish of small, clear, cool, headwater streams. While it would, of course, be physically possible for it to swim across a much larger river than the Ohio, all the evidence indicates that it strictly avoids warm, sluggish, silt-laden waters. I believe that its distribution pattern in Ohio indicates that it has survived all three glacial periods of the Pleistocene practically in situ.

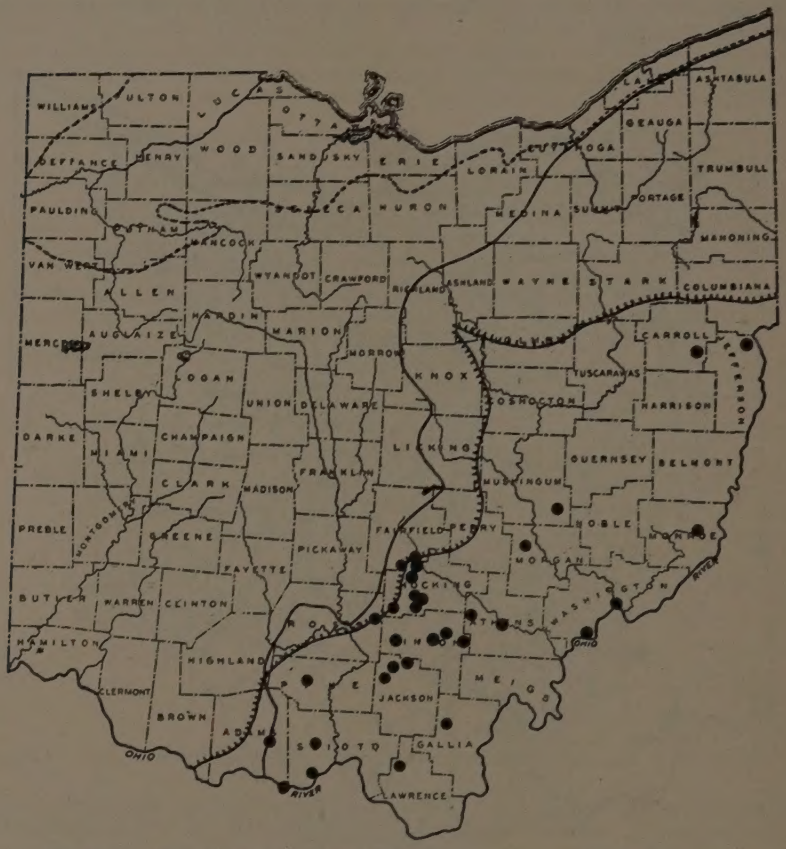

FIGURE 6. Ohio distribution of the upland chorus-frog. From Walker, 1946.

A considerable portion of the unglaciated Plateau along the glacial border has been dissected by an intricate network of filled valleys of preglacial and interglacial streams. These have been filled sometimes with many feet of lake silts and outwash. In some cases, glacial outwash is plastered high up on the adjacent valley walls, and in many cases limestone outwash has been washed many miles into a Plateau consisting largely of acid sandstones. While the mature uplands of the unglaciated Plateau are noteworthy for their lack of swamps and ponds, these are plentiful in the poorly drained filled valleys.

As a result, some of the filled valleys support a flora and fauna vastly different

from that of the unglaciated uplands, in many cases resembling that of the glaciated till plains. And whereas the preglacial valleys were often important migration routes for plants and animals from the south and southeast during pre-Pleistocene times, we now see a reverse migration taking place over the same valleys, since the filled valleys now serve as invasion routes for many species from the west which otherwise have been unable to penetrate the unglaciated Plateau. The striped chorus-frog, *Pseudacris triseriata*, is a conspicuous example (fig. 5). *Triseriata* is a western form, ranging as far west as Idaho and Arizona. It has, in comparatively recent times extended its range eastward along the Lake Plains to Oswego, N. Y. and it is widespread in the unglaciated Plateau of eastern Ohio, where it is restricted to filled valleys. The small spring pools of the unglaciated uplands are

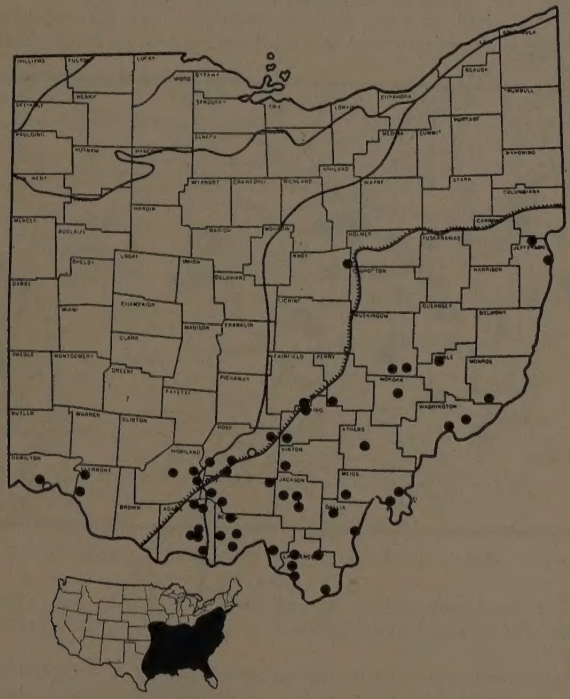

FIGURE 7. Ohio distribution of the fence lizard. From Conant, 1938.

utilized by *Pseudacris brachyphona*, an ancient and more primitive form. *Brachyphona* has not been able to spread beyond the unglaciated Plateau and I think that it is not too unreasonable to believe that it existed throughout the Pleistocene somewhere close to its present range (fig. 6).

The boreal element of our Ohio fauna is found mostly in the boreal relict bogs which occurred abundantly in the Wisconsin drift at the time of the arrival of the white man in America. Such bogs are rare or absent in the Illinoian drift and the border of the unglaciated Plateau, except in filled valleys. The bogs are rich in boreal animals, and since many of them lie adjacent to the unglaciated Plateau, the glacial border therefore presents the unusual picture of Canadian animals occurring in close proximity to animals of southern latitudes.

Among the numerous northern animals to be found in boreal relict bogs may be mentioned the Wilson's thrush, northern water-thrush, swamp sparrow, rose-breasted grosbeak, red-backed vole, woodland jumping mouse, the grasshopper, *Melanoplus borealis*, the copper butterfly, *Lycaena epixanthe* and the deer-fly *Chrysops frigida*.

While there are a limited number of relict plants of the Hemlock-Hardwoods forest in deep gorges in some portions of the glacial border, the northern fauna is poorly represented in such situations, due, possibly to their restricted area.

In early post-Wisconsin time, a considerable migration of Atlantic coast flora and fauna took place into the Great Lakes region possibly along the Hudson-Mohawk glacial outlet. Peattie (1922) has discussed the plants which took part in this invasion, but the animals accompanying them are not so well known. The migration consisted of two distinct elements: (1) Xerophilous plants and animals which presumably followed the sand and gravel outwash plains and which

FIGURE 8. Distribution of Kirtland's water snake. From Conant, 1943.

have survived in sandy situations around the Great Lakes and, (2) Hydrophilous flora and fauna which may have migrated by way of the swales and marshes along the same route.

Representative examples of the first category consist of the beach grasshoppers, *Trimerotropis maritima* which is widely distributed on sand dunes along the southern Great Lakes and the rarer *Psinidia fenestralis*. Another eastern grasshopper, *Scirtetica marmorata* is found in open sandy or rocky woodland.

The hydrophilous element from the Atlantic coastal plain seems to have survived largely in alkaline bogs, which apparently provide ecological conditions similar enough to those of the salt marshes and brackish situations of the Atlantic coast to have permitted the survival of this relict element for 10,000-odd years. That this flora and fauna may have been quite extensive in former times is indicated by the fact that isolated relicts occur in marl bogs at the foot of terminal moraines of the Wisconsin, 150 miles or more from Lake Erie.

A large group of Ohio animals consists of those which apparently existed in refugia just beyond the ice boundary to the south and southwest during the Wisconsin times. As with the Plateau fauna, a number of southern species have never been able successfully to invade glaciated territory, the northern boundary

of their range in some cases practically coinciding with that of maximum glaciation, or, in some cases, the Wisconsin terminal moraines. The range of the fence lizard or common swift *Sceloporus undulatus*, seems to follow this pattern (fig. 7)as do those of the cave salamander, *Eurycea lucifuga*, and the king snake, *Lampropeltis getulus*.

Many other species, of course, have invaded the glaciated territory far to the north. Some of these are known only from the middle west and may be considered middle-western endemics.

Kirtland's water snake, *Natrix kirtlandii* is a case in point (fig. 8). This small, secretive water snake is endemic to the eastern portion of the prairie peninsula, where it is practically confined to glaciated territory. To me, its distribution

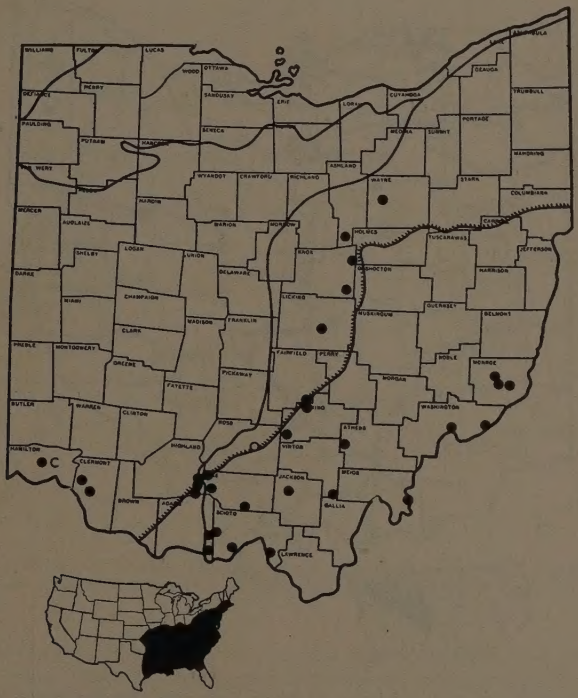

FIGURE 9. Ohio distribution of the copperhead snake. From Conant, 1938.

pattern suggests that it survived the Wisconsin glaciation somewhere close to the ice-front, spreading northward after the retreat of the ice. Unlike the prairie species it is not known west of central Illinois. If it retreated to Florida during the Wisconsin and subsequently returned to its present range, it has left no known relict colonies along the route, nor is there evidence that it can survive in unglaciated terrain. Two similar examples will be discussed later.

The Xerothermic period resulted in the invasion of a large element of prairie plants and animals. Schmidt (1938) has given an excellent account of the reptiles and amphibia of the Prairie Peninsula. To the examples listed by him may be added the plains garter-snake, *Thamnophis radix*, which has recently been found as

an isolated prairie relict as far east as central Ohio. Among the mammals, the badger and its favorite prey, the 13-lined spermophile are members of the prairie fauna which are known as far east as Ohio, while a great many prairie birds and insects accompanied the invasion of prairie plants eastward.

The occupation of North America by Europeans has resulted in the most radical change in the flora and fauna in a shorter period of time than any known phenomenon in the region under consideration. The clearing of the timber and the subjugation of the land to agriculture have converted a cool, moist habitat into a hot dry one. At the same time, every farm has become an artificial prairie. Radical changes have taken and are taking place in our fish populations, as Milton Trautman (1951) has shown. Fish species which require clear water have been

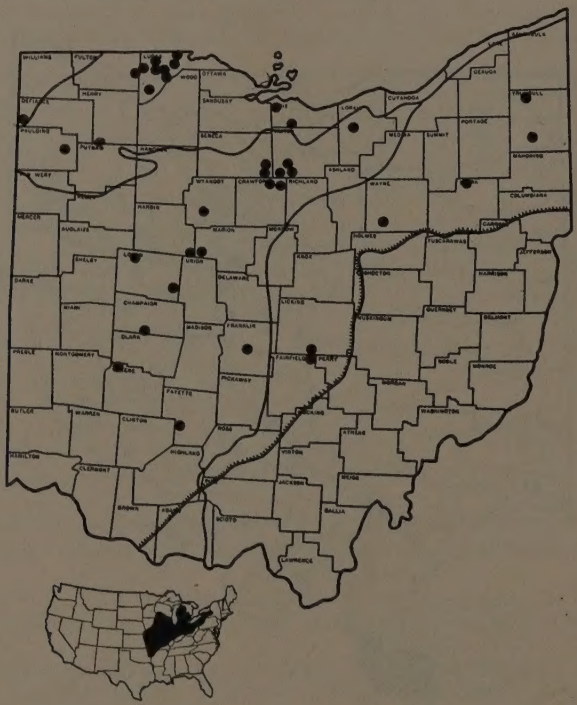

FIGURE 10. Ohio distribution of the massasauga. From Conant, 1938.

extirpated or decimated in numbers and are being replaced by those species which can tolerate a heavy concentration of silt from our corn fields.

Southern birds, such as the cardinal, Bob-white, tufted titmouse and the mockingbird are extending their range to the north. Birds and mammals of prairie-like habitats, such as the meadowlark, vesper sparrow, bobolink, prairie white-footed mouse and the fox squirrel are replacing birds and mammals of the forest. The small-mouthed salamander and the striped chorus-frog are increasing at the expense of such animals as Jefferson's salamander and the wood frog.

Perhaps the most dramatic invasion by a prairie animal has been that of the prairie horned lark, which has overspread the northeastern United States within the last 80 years (Pickwell, 1931). Its exact range at the time of the westward

influx of white settlers will probably never be known. Audubon knew nothing of nesting horned larks in the middle west.

The Xerothermic Period could not have failed to favor this bird and it very possibly enjoyed a wide eastern range at that time. However, it can not exist in tall-grass prairie any more than it can in forest. It requires sparsely vegetated habitats with short and scant ground-cover. At the time of the settlement of the middle-west, it may well have existed in scattered refugia in sandy areas, as Barrows and others contend. But if so, no evidence to that effect has been produced. While competent bird observers were few and scattered prior to the 1870's, there were enough of them to prove conclusively that nesting horned larks did not exist in certain large areas in the eastern United States where they are now plentiful.

FIGURE 11. Distribution of the *radix* group of garter-snakes. Open circles, *Thamnophis brachystoma;* squares, *T. butleri;* triangles, *T. radix radix;* solid circles, *T. radix haydenii.* From Smith, 1949.

The original range of the prairie horned lark may have been west of the Mississippi, possibly with limited extensions eastward into sandy areas in Wisconsin and Illinois. Coues reported nesting larks in Wisconsin in 1874, and in 1878 Ridgeway reported the birds abundant in suitable localities in Illinois, but these may well represent birds which had invaded from farther west.

The first definite evidence of an eastward invasion was a report by McIlwraith of larks nesting at Hamilton, Ontario, possibly as early as 1871. They were reported for western New York in 1875, for 3 additional localities in that state in 1876 and for Indiana in 1878. There were no records for Ohio when Dr. John M. Wheaton published his Birds of Ohio in 1880. After 1880, the species spread rapidly and now nests commonly over most of the northeastern United States and adjacent parts of Canada.

The general rule that it is the southern species which have increased their range with the destruction of the forests is subject to a number of exceptions in which northern animals have spread southward. The savanna sparrow and the

least weasel are examples and I believe the same to be true of the red fox, *Vulpes fulva*.

The case of the red fox is as remarkable as that of the lark but less well documented. Early settlers were almost unanimous in the belief that the red fox was absent from eastern North America until it was introduced from England for the purposes of sport. This belief, of course, did not take into account the fact that the European and our red fox are considered distinct species and further that the red fox group is widely distributed in northern North America, with a number of species and races, indicating long residence in the nearctic region.

There is little doubt, however, that *fulva* was a rare animal before the land was cleared by Europeans. The Ohio State Museum has a large quantity of animal bones from late prehistoric Indian village sites of the Fort Ancient culture. We have found as yet no unquestioned bones of red fox, though remains of gray

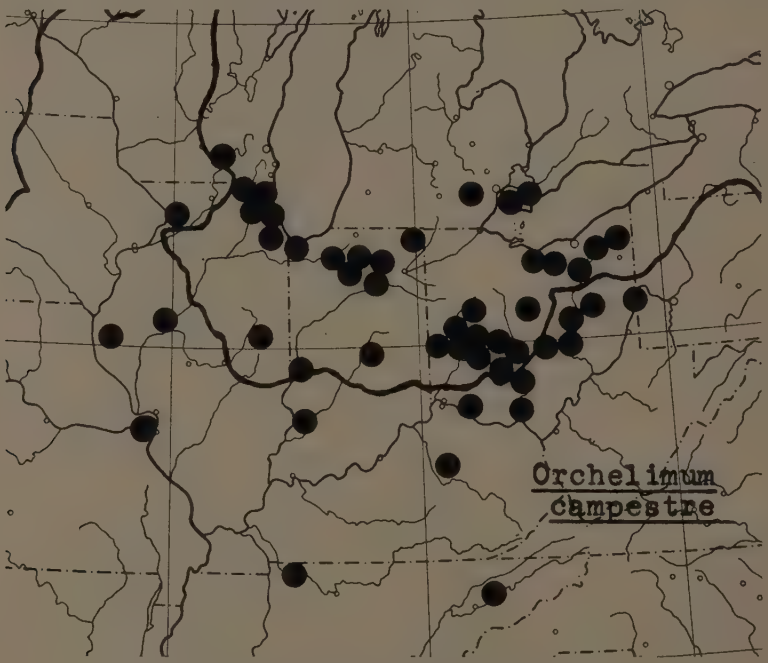

FIGURE 12. Distribution of the grasshopper, *Orchelimum campestre*. Heavy line indicates Wisconsin boundary.

fox (*Urocyon*) are plentiful. The red fox, like the savanna sparrow and the least weasel, already mentioned, is an animal of open country, while the gray fox is a woodland animal.

The fact that all the other North American species of the *Vulpes fulva* group are either northern or high mountain forms, may indicate that *fulva* also had a northerly range in pre-Columbian times, from which it spread southward and southeastward with the clearing of the forests.

It will thus be seen that climatic and cultural changes have resulted in the juxtaposition in our State of many varied faunas. I will conclude with a few striking examples.

Three species of moles of diverse origin occur along the glacial border. The star-nosed mole exists as a northern relict in relict bog habitats. The hairy-tailed mole is an Appalachian species which has never been able to extend its range more than a few miles west of the Plateau, while the Prairie Mole occupies all of the territory west of the Plateau and is apparently extending its range eastward.

The copperhead snake and the massasauga also occupy reciprocal habitats. The copperhead is so closely confined to unglaciated territory and the Illinoian drift that the northern limit of its range virtually presents a picture of the Wisconsin boundary (fig. 9). The massasauga on the other hand is restricted to wet prairie, or prairie-like habitats in the Wisconsin drift and its range closely parallels the Prairie Peninsula (fig. 10).

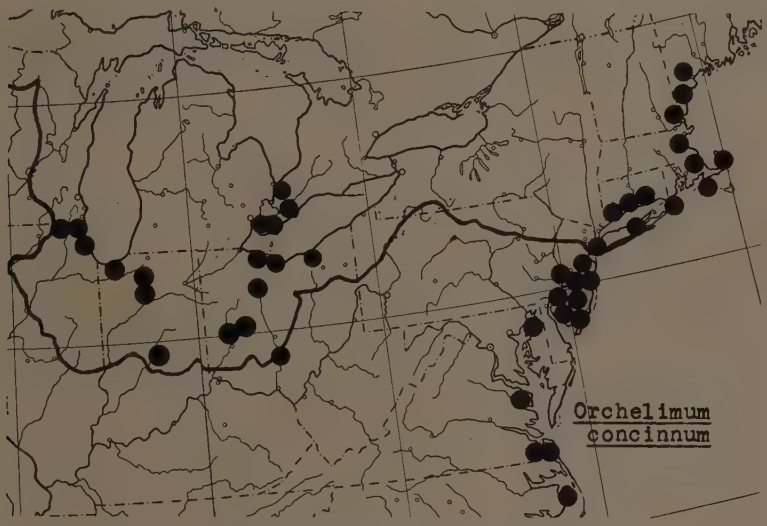

FIGURE 13. Distribution of the grasshopper, *Orchelimum concinnum*. Heavy line indicates Wisconsin boundary.

The garter snakes of the *radix* group provide an interesting distributional picture (fig. 11). *Thamnophis radix* is a western form, existing, I believe, as an isolated prairie relict of the Xerothermic Period as far east as Ohio. *Thamnophis butleri* like Kirtland's water snake, already noticed, is an endemic of the eastern portion of the Prairie Peninsula. Its distribution pattern seems to me to indicate that, like *kirtlandii*, it existed in refugia within glaciated territory during Wisconsin time, spreading northward after the retreat of the ice (Conant, Thomas, and Rausch, 1945). *Thamnophis brachystoma* is restricted to a small area in the unglaciated uplands of northwestern Pennsylvania and southwestern New York. Unlike *butleri*, it has been unable to invade glaciated territory for any great distance. I agree with Netting (*in* Conant, 1950, p. 76) in the opinion that it is undoubtedly a pre-Wisconsin relict, and that it may well have survived throughout the Wisconsin not far from its present range.

Possibly the most striking picture of all is provided by the distribution of three grasshoppers of the *Orchelimum concinnum* group. These three are so closely related that Orthopterists currently recognize only one species with two geographic races, considering the third form an absolute synonym. I consider the three

distinct species, since they exist together in a number of places without evident intergradation.

Orchelimum campestre is another of the middle western endemics and is widely distributed in marshes throughout the Wisconsin drift, into which, I believe, it spread from refugia not far from the ice front (fig. 12). *Orchelimum concinnum* is abundant along the Atlantic seaboard, but it exists as a relict species in marl bogs and other alkaline marshes in the southern portion of the Great Lakes region (fig. 13). There is little question but that it spread into the latter area from the Atlantic coast in early post-Wisconsin times. The third species, *Orchelimum delicatum* has a wide range west of the Mississippi, but it exists eastward as a relict of the Xerothermic period in a few grassy swales, mostly those adjacent to sand dunes (fig. 14).

Speciation in this group has apparently taken place as a result of isolation during the Pleistocene, after which the strange vagaries of climate enabled the three forms again to come in contact along the glacial border in the middle west.

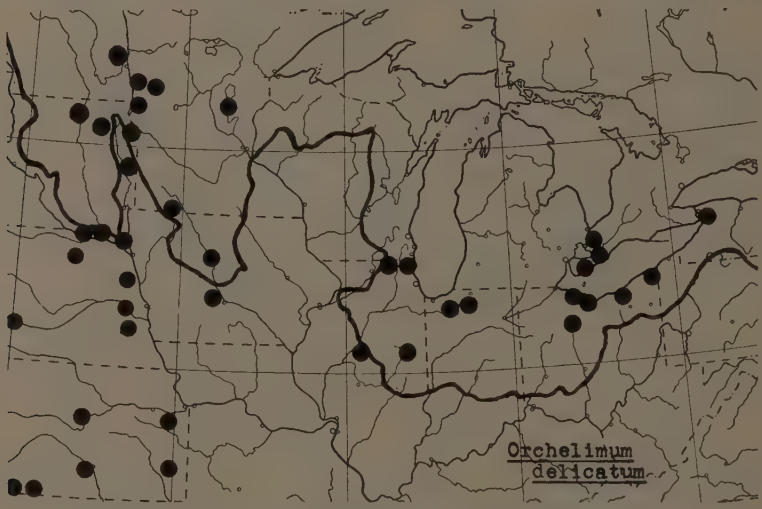

FIGURE 14. Distribution of the grasshopper, *Orchelimum delicatum*. Heavy line indicates Wisconsin boundary.

I hope that the brief sketch which I have presented will illustrate the wealth and diversity of the Ohio fauna, as well as the complexity of its sources of origin, both in time and space. The distribution and the ecology of many Ohio animals, I believe, raises a strong presumption that they survived the Wisconsin or perhaps the entire Pleistocene close to the glacial border, some species in refugia within the limits of glaciated territory.

The problem is so complex and concrete evidence as yet so meagre, that many of my interpretations may be incorrect. Very possibly all of them are. If so, perhaps this paper may stimulate some other worker to uncover evidence which will provide us with a more accurate picture.

ACKNOWLEDGMENTS

I am indebted to a number of persons for valuable criticisms and suggestions, especially to the following: Dr. E. Lucy Braun, Department of Botany, emeritus,

University of Cincinnati; Dr. Richard P. Goldthwait, Department of Geology, Ohio State University; Drs. Charles F. Walker and Theodore H. Hubbell, Museum of Zoology, University of Michigan, and Dr. John M. Wolfe, Department of Botany, Ohio State University.

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The 1952 Annual Meeting of the Ohio Academy of Science will be held at Kent State University, Kent, Ohio, on April 17, 18, and 19.

THE OHIO JOURNAL OF SCIENCE AWARD FOR EXCELLENCE IN RESEARCH

The Ohio Journal of Science will offer awards to persons presenting outstanding original research papers in fields of science represented by sections of the Ohio Academy of Science. For the current year the field of Chemistry has been chosen by the Joint Administrative Board of The Ohio Journal of Science.

Award

The award for 1952 is $150.00 for the outstanding paper selected in the field of chemistry.

Eligibility

1. The participant must be a member of the Chemistry Section of The Ohio Academy of Science.
2. The manuscript must be either (a) unpublished or (b) published in the Ohio Journal of Science after July 1, 1951.
3. The manuscript must be based upon original research conducted by the participant.
4. The following are not eligible participants: members of the editorial or management staff of The Ohio Journal of Science, members of the Joint Administrative Board, members of the Committee of Judges.

Rules

1. Each participant must submit two copies of his manuscript complete with figures or photographs of figures or two reprints of papers already published in The Ohio Journal of Science to the Editor on or before January 1, 1952.
2. If unpublished, the manuscript must be in a form suitable for publication.
3. The right to publish any or all of the unpublished manuscripts submitted, whether prize-winning or not, shall remain with The Ohio Journal of Science until one month after the 1952 meeting of The Ohio Academy of Science. On or before this date, the Editor of The Ohio Journal of Science will return to the authors those manuscripts which he does not choose to publish in The Ohio Journal of Science. Authors of these papers will then be free to publish the results of their research anywhere they choose. At the same time the Editor of The Ohio Journal of Science will inform the authors of those papers which the Editor wishes to publish in The Ohio Journal of Science of this fact, and will set an approximate publication date which will be not later than May 1, 1953.
4. A summary of the paper is to be presented by the author at the 1952 meeting of The Ohio Academy of Science unless the paper has already been published in The Ohio Journal of Science, or unless the program committee of the Chemistry Section finds it not feasible to do so.

Selection of Award Winners

1. The Vice President of the Section on Chemistry of The Ohio Academy of Science will choose a Committee of Judges composed of three or more members qualified to judge the manuscripts submitted. The Vice President will designate one of the judges to serve as chairman.
2. The Editor of The Ohio Journal of Science will transmit the manuscripts and reprints submitted to the Committee of Judges.
3. The Committee will select the award winner. The Committee has the obligation to refuse to make an award if, in its opinion, none of the manuscripts is sufficiently high in caliber to be so honored.
4. The winner of the award will be announced immediately at the close of the last session of the Chemistry Section at the 1952 meeting of The Academy of Science.

SIXTEEN NEW LEAFHOPPERS AND NOTES (HOMOPTERA: CICADELLIDAE)

DOROTHY J. KNULL

Department of Zoology and Entomology, The Ohio State University, Columbus 10

During the past fourteen years of intensive collecting, many puzzling forms of leafhoppers have been taken. Some of these, a rather miscellaneous assortment, are described here. Study has progressed with the constructive help of Dr. P. W. Oman of the U. S. National Museum and Dr. R. H. Beamer of the University of Kansas. To them and especially to Prof. Josef N. Knull for drawings, collecting and other help, I wish to express gratitude.

Unless other deposition is mentioned, type material described here is deposited in the Collection of The Ohio State University.

Alconeura splendida n. sp.

Plate II, Figures 1, 5, 6

Near *A. tricolor* (V. D.) but not black below. No black dot in apex of elytron, but genitalia and venation place it in *Alconeura*. In form of inner ♂ genitalia near *A. balli* Beamer, but with narrower aedeagus and straighter pygofer spine.

Head bluntly produced, shorter than pronotum in ♂, almost as long in ♀. Background cream-colored with irregular red spots, on vertex two before middle and four behind between eyes; pronotum with two large discal spots separated medially by narrow pale area, five to seven irregular small spots on each side; scutellum with basal angles, two median basal streaks, and a small triangle either side of apex before tip. Elytra golden with a small hyaline area in base of inner apical cell. Dorsum golden with thorax and last abdominal segments darkened. Face below apex orange, legs and venter greenish yellow, somewhat darkened, giving sordid general appearance.

♀ last ventral segment long, triangular, produced to blunt tip, convex, ovipositor dark brown. ♂ aedeagus in lateral view twice as long as width at base, apical portion at right angle to base and less than half as wide, three lanciform processes, two lateral and one heavier ventro-median, arising in basal third and extending to apical third, parallel to shaft and separated from it by its width; lateral processes narrower, extending half length of shaft along its ventral surface. Pygofer spine slender, almost as long as aedeagus, tapering from base to sharp tip, and curving gently ventrad.

Length: 2.6 mm.

Taken in California: ♂ holotype, 2 ♂ paratypes, allotype and 6 ♀ paratypes, Palm Springs, Riverside Co., June 5, 1946; 1 ♀ June 19, 1941; and 2 ♀ paratypes, Santa Rosa Mts., Riverside Co., May 27, 1946, D. J. & J. N. Knull, in collection of writer.

Empoasca mira n. sp.

Plate I, Figure 9

A minute, brilliantly colored and intricately patterned species, appears cross-banded.

Head bluntly produced. Background of head, pronotum and scutellum and discal elytral crossband white, with bright red vermiculate mottling as illustrated. Red darkens toward mid-posterior part of pronotum and on scutellum becomes almost black at margins of apex. Elytra golden with broad white, irregularly red-margined, transverse area occupying middle third of clavus and adjacent corium, not reaching costa. Narrow red markings encircle this white saddle and branch through it with a larger darker red blotch on posterior claval half of it. Tips of elytra hyaline, veins pale, area before and below crossveins washed with dark smoky, especially dark near veins. Below green to yellowish green, legs near joints and tips bright

blue green, head white with bright red vermiculate markings becoming orange toward clypeus. Dorsum of abdomen dark.

♀ last ventral segment long, transverse, faintly produced, twice as long as preceding segment. ♂ styles swollen at base, narrowed to sharp out-turned apices, outer lateral margin sinuate. Lateral processes narrowed to fine, sharp, out-turned tips on apical fourth. Aedeagus short and straight with dorsal lip and pair of small spines on ventral base; spine of ninth segment with bulbous base and sharp projection longer than width of base extending ventrad from lower corner, curved, forming semicircle with base.

Length: 2.2 mm.

♂ holotype, allotype, 3 ♂ and 1 ♀ paratypes, Chisos Mts., Texas, July 17, 1946, D. J. & J. N. Knull, in collection of writer.

Erythroneura fiduciaria n. sp.

Plate I, Figure 10

A large red species of the Vulnerata Group related to *E. tecta* McAtee and nearest to *E. calva* Beamer.

Vertex ivory with median pagoda-shaped red spot including narrow longitudinal pale area which does not reach base, and two minute pellucid spots before apex; orange spot against eye connected with median spot basally. Pronotum red with three small ivory spots, one at mid-anterior margin, one behind it below inner eye corner; posterior margin narrowly pale smoky, disk somewhat darkened. Scutellum red with mid-basal spot and transverse bar below impressed line, ivory. Elytra red but for a basal heart-shaped white spot below scutellum, narrow, irregularly formed pale diamond around red claval apical third, small diamond on corium before plaque reaching claval vein; costal area whitish hyaline with large, roughly oval black spot in lower part of plaque; crossveins red, apical cells hyaline with smoky vitta based in upper half of two inner cells and extending diagonally to lower outer margin. Below pale with dark spot below eye; mesosternum, dorsum and sides of pygofer darkened.

Length: 3.6 mm.

♀ holotype, Great Smoky Mt. National Park, Tennessee, 5,000–6,000 ft., June 21, 1942, D. J. & J. N. Knull, in collection of writer.

Erythroneura maga n. sp.

Plate II, Figures 15, 16, 23

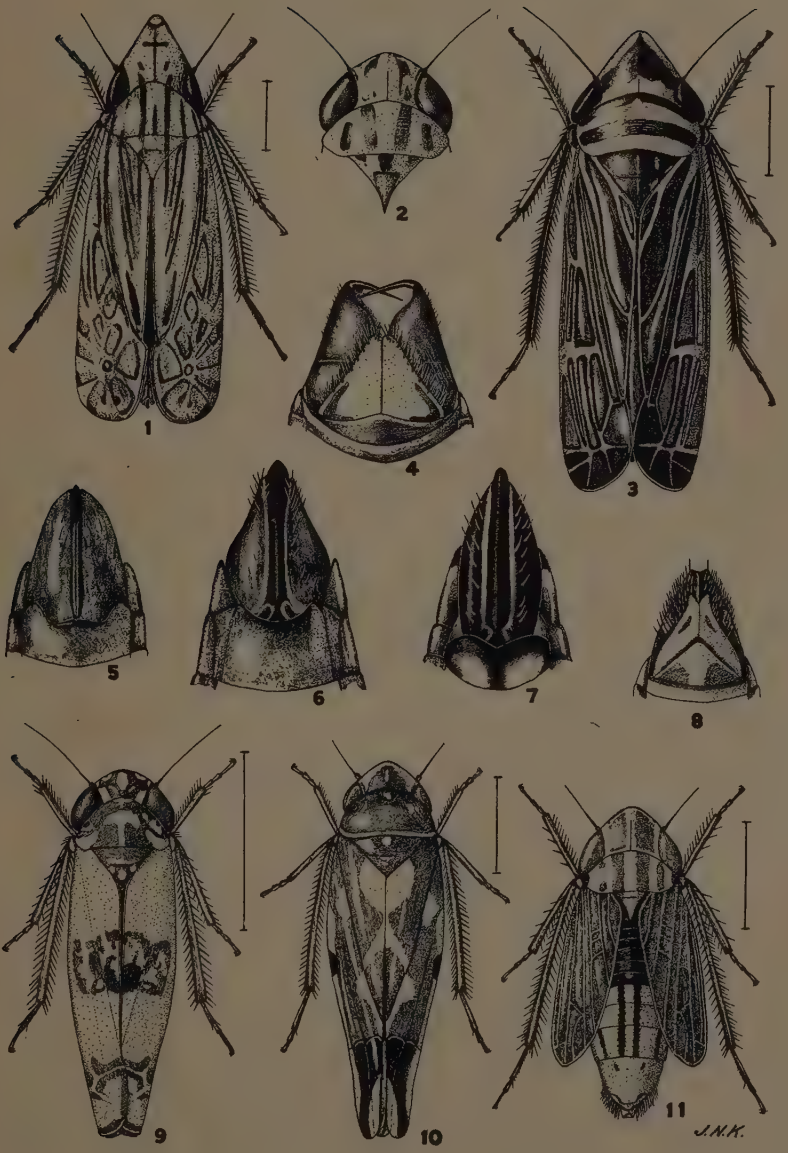
In the Maculata Group near *E. solita* Beamer and *E. macra* Beamer, but with longer, heavier pygofer hook and foot with more drastically curved base and longer, heavier posterior point.

Ground color white with pale orange diffuse markings. Vertex with three rounded white spots margined by thin orange bands. Pronotum with median oblong spot with indications of two small forward prongs not reaching margins; triangular spot behind each eye. Scutellum with tip orange, basal angles pale except for orange outer corner. Elytral markings diffuse, three spots on clavus; corium with dash near base, another extending diagonally from anterior end of plaque toward apex of clavus. Black spot at posterior end of plaque and one a little larger in base of cell M_4. Small red spot at margin on outer crossvein. Venter creamy white.

♂ pygofer hook single, heavy, straight, extending to tip of pygofer, with blunt teeth on outer fourth of inner margin. Style with large foot; base curved strongly; heel large, directed down; anterior point short and sharp, less than right angle; posterior point very heavy, broad at base, and almost as long; straight, tip blunt. Aedeagus of medium size, a straight cylinder with rounded tip.

EXPLANATION OF PLATE I

1. *Flexamia miranda* n. sp. ♀. 2. *Laevicephalus paulus* n. sp. ♂. 3. *Cochlorhinus atratus* n. sp. ♀. 4. *Ballana diversa* n. sp. ♂ genitalia. 5. *Flexamia miranda* n. sp. ♀ genitalia. 6. *Ballana diversa* n. sp. ♂ genitalia. 7. *Cochlorhinus atratus* n. sp. ♀ genitalia. 8. *Mocuellus perdignus* n. sp. ♂ genitalia. 9. *Empoasca mira* n. sp. ♂. 10. *Erythroneura fiduciaria* n. sp. ♀. 11. *Mocuellus perdignus* n. sp. ♂.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Length: 3 mm.

Described from 10 ♂ specimens from Scioto Co., Ohio, holotype and 5 paratypes, June 9, 1943; 3 paratypes June 15, 1944; and 1 June 9, 1945, D. J. & J. N. Knull, in collection of writer.

Erythroneura fausta n. sp.

Plate II, Figures 25, 26, 27

Similar in characters of inner ♂ genitalia to *E. knighti* Beamer, but with shorter aedeagus and pygofer hook.

Color and pattern as in *E. maga*, except that angles of scutellum are pellucid orange, basal claval spots are joined, outer crossveins red and black spot in base of cell M_4 is of medium size.

♂ pygofer hook stout, straight, curving in faintly toward apex, narrowed to sharp tip, as long as pygofer. Style heavy, heel large, projecting, blunt; base short, straight, thin toward toe; anterior point prominent, long, narrow, blunt, as long as base of posterior point, meeting base at less than right angle curve, longer than foot, tapering from broad base to sharp tip. Aedeagus short, spiny, with rounded tip.

Length: 2.8 mm.

♂ holotype, Hocking Co., Ohio, June 20, paratype, April 12, 1945, D. J. & J. N. Knull; paratype, Coalgrove, Ohio, April 24, 1934, J. S. Caldwell, in collection of writer.

Erythroneura spinea n. sp.

Plate II, Figures 20, 21, 22

Inner ♂ genital characters near those of *E. tantilla* Beamer and *E. trautmanae* Knull, but with larger aedeagus than in the former, and differently shaped pygofer hook with fewer teeth than in the latter.

Ground color yellowish white, orange markings. Vertex with some pellucid spots, four forming square from base on median third; pronotum with small irregular orange triangle on middle, an irregular arc of pellucid spots behind anterior margin. Tip of scutellum orange, base pellucid. Clavi with large basal anchor-shaped spot and spot at apex; costa, vitta before humeral angle, angulate vitta more or less surrounding plaque and joined to one opposite apex of clavus; outer crossvein bright red, small black spot in base of cell M_4, venter creamy and pellucid.

♂ pygofer hook single, S-curved, widened on outer two-thirds, with three prominent teeth on inner margin. Style with small foot; heel large, projecting; base slightly curved; anterior point small, projecting sharply; posterior point as long as base of foot, curving gently in; aedeagus long, straight and narrow in ventral view; very broad in lateral view and with many small teeth on dorsal portion, tip broadly rounded.

Length: 3 mm.

♂ holotype, Ames, Iowa, July 1, 1895, E. D. Ball Collector, in the Herbert Osborn Collection, The Ohio State University.

Erythroneura tersa n. sp.

Plate II, Figures 12, 13, 14

In characters of inner ♂ genitalia near *E. dira* Beamer and *E. direpta* Knull, but with pygofer hook as in *E. torella* Rob.

Ground color creamy white with orange markings. Vertex with semblance of five white

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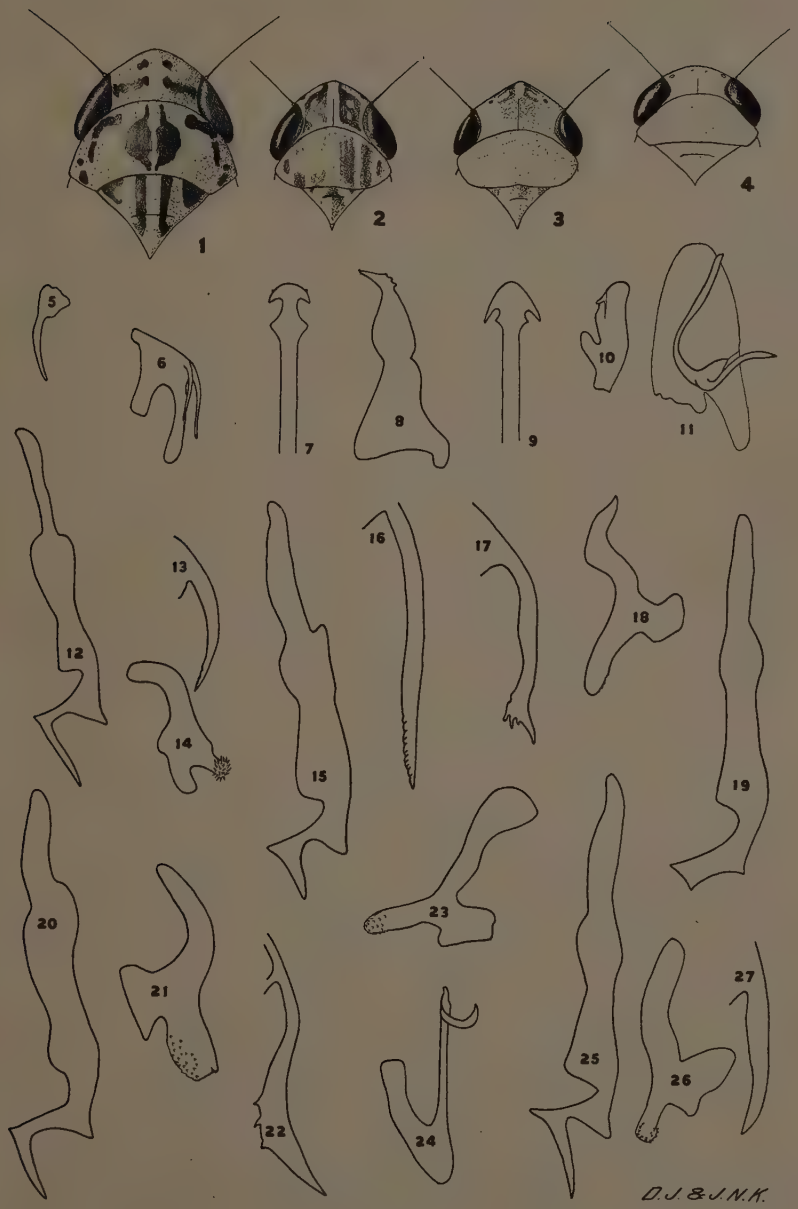
EXPLANATION OF PLATE II

1. *Alconeura splendida* n. sp. ♂. 2. *Laevicephalus canyonensis* n. sp. ♂. 3. *Laevicephalus obvius* n. sp. ♂. 4. *Aligia riscoana* n. sp. ♂. 5, 6. *Alconeura splendida* n. sp., pygofer spine, aedeagus. 7. *Laevicephalus canyonensis* n. sp., aedeagus. 8, 9. *Laevicephalus obvius* n. sp., style, aedeagus. 10, 11. *Aligia riscoana* n. sp., aedeagus and pygofer. 12, 13, 14. *Erythroneura tersa* n. sp., style, aedeagus, pygofer hook. 15, 16, 23. *Erythroneura maga* n. sp., style, pygofer hook, aedeagus. 17, 18, 19. *Erythroneura cristata* n. sp., pygofer hook, aedeagus, style. 20, 21, 22. *Erythroneura spinea* n. sp., style, aedeagus, pygofer hook. 24. *Laevicephalus canyonensis* n. sp., aedeagus. 25, 26, 27. *Erythroneura fausta* n. sp., style, aedeagus, pygofer hook.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D.J. & J.N.K.

spots more or less surrounded with bands of color. Pronotum with median triangular or sometimes rectangular spot not touching either margin and angular spot back of each eye. Scutellum with tip red and basal angles yellow. Clavi with basal anchor-shaped mark and spot before tip. Coria with angulate spot on costa before humeral angle, another broken vitta arising on costa at anterior end of plaque, more or less surrounding it, ending on mesal margin near tip of clavus in enlarged area. Outer crossvein red. Small black spot in base of cell M_4 and smaller one in posterior end of plaque. Tips of elytra smoky. Venter stramineous.

♂ pygofer hook stout at base, short, tapering to sharp tip and turned in. Style of medium size, base curved, heel projecting out, less than a right angle; anterior point almost a right angle, inconspicuous; posterior point longer than base of foot, narrow, straight, sharp, meeting base in a broad curve. Aedeagus quadrate, spiny.

Length: 3 mm.

Described from a series of ♂s, holotype, seven paratypes, five specimens, Hocking Co., Ohio, April 12, 1945, D. J. & J. N. Knull, in collection of writer.

Erythroneura cristata n. sp.

Plate II, Figures 17, 18, 19

General ground color white, semihyaline, markings orange, pellucid anteriorly. Vertex with basal pellucid V at middle with lateral extension to each eye enclosing pale square; faint dash at apex; pronotum with median Y reaching margins and angular spot behind each eye; scutellar angles pellucid. Elytra hyaline with dark tips, red dash on outer crossvein; anchor spot on basal clavus and spot near apex diffuse, orange; corium with spot near humeral angle, parallel vittae originating at ends of costal plaque and extending down anterior to apex of clavus and posterior to base of cell M_4. Round black spot in base of cell M_4 and dot in posterior end of plaque.

♂ pygofer hook swollen at middle, narrowed, then broad on apical fifth, with outer point broad, sharp, turned out and four sharp irregular teeth, with some smaller ones on rounded inner margin. Aedeagus large, long, oval, with a few minute teeth on posterior margin in lateral view near apex.

Length: 2.5 mm.

♂ holotype, Scioto Co., June 10, 1944, D. J. & J. N. Knull, in collection of writer.

Cochlorhinus atratus n. sp.

Plate I, Figures 3, 7

Near *C. bidentatus* Beamer in coloring and form of ♀ genital segment, but larger and with head more produced.

Large, robust, with vertex and pronotum alternately straw and black banded, elytra with all cells dark brown to black, all veins pale and raised. Vertex as long as pronotum, shorter than basal width, triangularly produced, disc depressed, pale, thin margin including ocelli narrowly carinate above, transverse dark band on disc produced medially; pronotum broadly rounded in front, slightly emarginate behind, marked with four almost equally wide transverse bands, anterior dark, dark bands not reaching lateral margins. Scutellum chiefly black with indications of lighter areas. Below, black, but for pale transverse band crossing lower half of face, anterior part of genital segment and edges of pygofer along ovipositor. Legs dark, tibiae white-lined inside.

♀ segment a little longer than preceding, lateral lobes broadly rounded from base to posterior margin which is broadly and shallowly emarginate.

Four ♀s, holotype and paratypes, Clear Lake, Lake Co., California, June 18, 1941, D. J. & J. N. Knull.

Ballana diversa n. sp.

Plate I, Figures 4, 6

Smaller than but resembling *B. dissimilata* (Ball). ♂s green, ♀s brown, mottled.

♂. Head yellow, half longer at middle than next to eye, a little shorter than pronotum, obtusely angled, disc depressed, ocelli dark brown, uppermost dark arc of front visible from

above, eyes dark, traces of light brown markings with pair of spots above base nearer eye than middle. Pronotum green with paler anterior and lateral margins; scutellum yellowish green. Elytra green with veins paler especially toward apex; apical cells and costa on apical half fumose. Dorsum black. Below mostly straw colored, face with eight light arcs.

♀. Vertex and anterior portion of pronotum yellow, with scutellum irrorate with brown; elytra milky subhyaline, heavily irrorate with brown, apical veins pale and tips more solidly brown.

♀ segment half as long as basal width, narrowed strongly below base, and produced, narrowing a little, to shallowly excavated broad apex; lateral lobes round; black, longitudinally striate area either side of center of excavation; whole segment convex.

♂ genitalia as a whole from ventral view almost square. Valve bluntly triangular, a little longer at middle than preceding segment. Plates together as long as basal width, narrowed gradually to bluntly round tips, exceeded by pygofer half their length. Pygofer sides straight, terminating ventrally in long transverse black spines which narrow to sharp crossed, upturned tips, often visible in uncleared specimens. Seen from the dorsal view, each spine has a smaller spine projecting in from base, and there is a heavy, short, strongly out-curved spine either side of anal tube. Styles with long finger-like projection inside, reaching half length of plate. Aedeagus narrow, strongly S-shaped, slightly wider before long narrow, sharp tip.

Length: 5.8 mm.

Collected from manzanita (*Arctostaphylos* sp.) near Carrizo, Arizona, ♂ holotype, allotype, 17 ♂ paratypes, 34 ♀ paratypes, July 18, 1950, D. J. & J. N. Knull. Paratypes sent to U. S. National Museum and University of Kansas Collections.

Aligia riscoana n. sp.

Plate II, Figures 4, 10, 11

Resembling *A. lutea* Hepner, but larger, apex of pygofer in ♂ rounded instead of triangular, and aedeagus stouter.

Vertex rounded, parallel-margined, half as long as pronotum, transverse groove definite; crossveins sparse, inconspicuous except where darkened toward apex.

Color. Golden yellow in ♂, paler in ♀, with basal angles of scutellum bright yellow; elytra with dark spot in apex of clavus and inner apical cells darkened as well as veins and costal reflexed veinlets.

♂ genitalia: pygofer elongate, broadly rounded at tip, pygofer hook bifid, outer prong extending to apex, blunt-tipped, a little broader on outer half; inner prong half as long, outer third broader, somewhat leaf-like, tip sharp, curved out at apex. Aedeagus short and broad in lateral view, with short, triangular latero-dorsal spine before apex. Styles twice as long as basal width, sinuately narrowed to outer third, with blunt apices.

♀ segment transverse with narrow median tooth produced about one-third length of segment.

Length: ♂ 5.2 mm.; ♀ 5.6 mm.

♂ holotype, allotype, 1 ♀ paratype, Chiricahua Mts., Arizona, Sept. 29, 1947; a ♀ paratype, Huachuca Mts., Arizona, Sept. 9, 1938, D. J. & J. N. Knull.

Mocuellus perdignus n. sp.

Plate I, Figures 8, 11

Related to *M. collinus* (Boh.) but much smaller, and similar in character of external ♂ genitalia to *M. larrimeri* (DeL.) but with broader valve and shorter plates.

Robust, straw colored with darker brown markings in form of longitudinal stripes, broad blunt head, and elytra not covering abdomen.

Head half longer at middle than next to eyes, blunt, rounded to front, as long as pronotum with two broad dark stripes from just below anterior margin to base, extending across short pronotum where they are a little narrower. A pair of still narrower stripes on pronotum extending behind inner eye corners and a third pair near short lateral margins. Pronotum broadly rounded in front, slightly emarginate behind, with very narrow sharp lateral margins. Scutellum small, stripes indicated as continued over basal angles, tip sharp, pale. Dorsum dark basally, light background on abdominal segments with dark area separating into four narrow longitudinal dark

stripes reaching pale pygofer. Elytra straw-colored, semi-hyaline with veins paler, broad, appearing slightly raised, three crossveins in outer clavus, reaching base of pygofer, narrowed apically to rounded tips.

Below, face pale with dark arcs, abdomen dark with lateral margins broadly pale to last abdominal segment which is pale with narrowly dark posterior margin; valve with triangular dark area either side before middle, plates pale with elongate streak near middle, and pygofer dark and hirsute. Valve triangular, as wide as plates at base, twice as long as segment, blunt apex; plates extending length of valve beyond it, narrowing to rounded tips, apically divergent; pygofer extending half length of valve beyond plates, edges carinate, overlapping slightly at apex. Styles visible from side (specimen not dissected) of medium size, parallel margined to apex where they are broadened, rounded on inner side, apex transverse, and produced laterad on outer side in sharp point half as wide as shank.

Length: 3.2 mm.

♂ holotype, Yosemite National Park, Mariposa Co., California, August 1, 1940, D. J. & J. N. Knull.

Laevicephalus paulus n. sp.

Plate I, Figure 2; Plate II, Figure 24

Remarkable for difference in form of head in ♂s and ♀s. In ♂ blunt head is not as long at middle as is pronotum; in ♀ it is triangularly produced, a little longer than pronotum.

Color. Ground color cinereus, frontal sutures brown, frons with brown arcs coalescing medially. Vertex with median brown inverted U with arms projecting toward ocelli, and elongate dash either side on base next to eye. Pronotum with six longitudinal stripes, the inner pair approaching one another basally. Scutellum with basal angles, median spot and apex brown. Elytra grayish subhyaline with cell margins embrowned. Elytra exceeding abdomen.

Genitalia. ♀ last ventral segment long, roundly and a little sinuately produced. ♂ valve small, triangular, plates long, broad as pygofer basally, tapering gradually to rounded tips, reaching two-thirds of way to apex of spiny pygofer. A single row of long white spines on lateral margins of plates behind which is a row of fine longer hairs. Spines of pygofer thick and dark. Aedeagus shaft long and straight, tip knobbed with pair of semi-circularly curved lateral processes crossing tips ventrally, shaft slightly more than a third longer than basal arm.

Length: ♂ 3 mm.; ♀ 3.6 mm.

♂ holotype, paratype, 2 ♀ paratypes, Patagonia Mts., Arizona, August 20, 1940; and allotype, 2 ♂ paratypes, August 7, 1950, D. J. & J. N. Knull.

Laevicephalus canyonensis n. sp.

Plate II, Figures 2, 7

Smaller than, but very similar to *L. paulus* but with different aedeagus and color pattern on head. Lateral stripes meet on apex, have projections to just below ocelli and basally form squares with white dot in center either side of middle and against eyes. Pronotal stripes wider than in *L. paulus*.

♀ genital segment long, sides sharply emarginate at half length to median half which is produced in a broad truncate median lobe. ♂ genitalia as in *L. paulus* but with plates and pygofer more constricted at middle. Aedeagus with very long straight narrow shaft, twice as long as base, ending in rounded tip with straight sides, and just before it, a lateral blunt tooth projects on either side.

Length: ♂ 2.5 mm.; ♀ 3 mm.

♂ holotype, allotype, 1 ♂ paratype, Sabino Canyon, Arizona, July 30, 1950; a ♀ paratype, Tucson, Arizona, August 27, 1938; 1 ♂ paratype, Mt. Lemmon, Arizona, August 2, 1950, D. J. & J. N. Knull.

Laevicephalus obvius n. sp.

Plate II, Figures 3, 8, 9

Similar in form and coloring to *L. aridus* Oman, but larger.

Color. Pale greenish white, head and scutellum yellow-tinged, front with distinct brown bars full length, vertex with curved brown dashes either side of apex, approaching ocelli; eyes dark, and dark dorsum showing through elytra gives sordid appearance to insect.

Vertex bluntly produced, almost as long as pronotum in ♀, two-thirds as long in ♂. Elytra extending well beyond tip of abdomen, veins straight, regular, pale green.

♀ segment very large, produced half its length in a broad rounded median lobe, sides sinuate, slightly notched at middle, and often appearing creased at center from base. Ovipositor black. ♂ valve equilaterally triangular, small, not as wide as preceding segment. Plates long and broad, narrowing gradually to rounded tips; exceeded by pygofer two-fifths their length. Aedeagus with long narrow shaft as in *L. canyonensis*, ending in rounded tip with sharp up-turned corners and often with small lateral point just before tip. Style with three or more rounded protuberances on heel part of apical foot-like structure which is heavily chitinized.

Length: ♂ 3.4 mm.; ♀ 4.2 mm.

Taken in mountains of southern Arizona: ♂ holotype, allotype, 16 ♂ and 20 ♀ paratypes, Huachuca Mts., August 12–19, 1950; 78 ♂ and 51 ♀ paratypes, Patagonia Mts., August 7, 1950; Chiricahua Mts., August 28, 1940, 2 ♀s; Sept. 5, 1947, 1 ♂, 5 ♀s; Sept. 12, 1947, 1 ♀; Sept. 14, 1938, 1 ♀; Tucson Mts., August 1, 1950, 1 ♂; Sabino Canyon, July 30, 1950, 1 ♂, 1 ♀, D. J. & J. N. Knull; 1♂, 6 ♀, Huachuca Mts., Arizona, Sept. 5, 1936, E. D. Ball, received for study from and returned to U. S. National Museum.

Flexamia miranda n. sp.

Plate I, Figures 1, 5

Closely related to *F. mexicana* DeLong & Hershberger, but shorter head and distinct ♀ genital segment.

Large, creamy white with dark brown markings and long, flaring elytra exceeding abdomen. Vertex flat, strongly produced, bluntly pointed, as long as pronotum and about as long as basal breadth between eyes.

Color. Vertex pale, tip encircled by an irregular dark band, a transverse bar marking apical third, a pair of pellucid marks appears midway between upper corners of eyes and center, each as far from each other as from eyes. Nine narrow longitudinal stripes on pronotum, median on basal two-thirds, inner pair extending on to vertex base briefly, two inner pairs cross scutellum on inner and outer margins of basal angles, outer short pair on lateral margins. Elytra pale with area either side of center length of clavus immaculate, veins narrowly and irregularly brown margined, apical and costal cells washed with light brown.

Below, face pale, except for dark anterior band which contains five pale lines, a band across antennal cavity, eye margin and mesonotum, dark thorax, margins of abdominal segments and bases of spines and some bands and lines on legs dark. Inner margin of genital segment black as is apical half of ovipositor.

♀ segment three times as long as preceding, excavated from rounded broad lateral angles to one-third its depth with faintly produced median lobe nicked at its center. Pygofer plump with round white discal spots at base of spines.

Length: 5.3 mm.

♀ holotype Huachuca Mts., Arizona, August 19, 1950, D. J. & J. N. Knull.

NEW OHIO RECORDS

Idiocerus telus DeLong & Hershberger, 1 ♂ Hocking Co., Ohio, April 12, 1949, D. J. & J. N. Knull.

Erythroneura (Maculata Group)

" *maga* Knull, *fausta* Knull, *tersa* Knull, and *cristata* Knull (this paper).

" *vittata* Knull & Auten, Hocking Co., April 12, 1945, D. J. & J. N. Knull.

Erythroneura coxi Ross & DeLong, Delaware Co., May 11, 1947, D. J. & J. N. Knull.

" *igella* Ross & DeLong, Hocking Co., April 12, 1945, D. J. & J. N. Knull.

" *quercalbae* Ross & DeLong, Hocking Co., April 12, 1945, D. J. & J. N. Knull.

" *rangifer* Ross & DeLong, Hocking Co., April 12, 1949, D. J. & J. N. Knull.

SYNONYMY

Erythroneura alternata Johnson, *Bull. Ohio Biol. Surv.* 31:72, 1935 (July 8) is a synonym of *E. cauta* Beamer, *Jour. Kans. Ent. Soc.*, 8:100, 1935 (July 1).

REPORT ON THE FIRST OHIO INTERCOLLEGIATE GEOLOGY FIELD TRIP

The Kent State Geological Society successfully operated the first Ohio intercollegiate geology field trip on May 5, 1951. The society members, composed of geology majors and other interested students, patterned the trip after the annual New England intercollegiate trips which have been functioning for over 40 years.

Nearly 100 practicing geologists, professors, students (graduate and undergraduate) and interested laymen visited the Cuyahoga Gorge Park northeast of Akron, Ohio, during the morning. Rocks and structures of Pennsylvanian and Mississippian age were examined and discussed. The Mississippian-Devonian rock section along Chippewa Creek east of Brecksville, Ohio, was visited in the afternoon session.

Student members of the geological society led the trip after distributing their own mimeographed 23-page resume including maps, diagrams, a plate of fossil types, and well log. Subject matter reviewed included glacial geology, geomorphology, paleontology and economic geology of the lower Cuyahoga valley region.

Numerous students and faculty members from the following universities were participants: Western Reserve, Ohio, Ohio Wesleyan, Bowling Green, Kent State, and Ohio State. Several representatives were present from the following organizations or institutions: Kirtland Geology Club, Ohio Division of Water Resources, U. S. Geological Survey, Cleveland Museum of Natural History, Akron Beacon Journal, and the Kent State Geological Society.

Judging by the enthusiasm shown in the field and later verbal and written comments, the idea of an intercollegiate field trip in which students, professionals, and laymen participate was highly endorsed and approved by all. One professor and a group of students left their section of the state at 3 A. M. in order to make the 8:30 A. M. trip departure time. The former was sufficiently enthusiastic to write the following post-field trip remarks: "The weather, the fine preparation by your people, and participation by numerous members of the trip combined to make it a very pleasant and successful one. Your students did a pioneering job in intercollegiate field tripping in Ohio that should be the example for others to follow."

It seems safe to say that Ohio geologists are looking forward to the next Ohio intercollegiate excursion.

It has been suggested that the Ohio Academy of Science, Section C (geology), "mother" an intercollegiate trip each year. This would place upon one specific individual the responsibility of seeing that successive trips are planned. Several Academy members favor the substitution of an intercollegiate trip for the recently initiated fall Academy of Science geology field trip. If this is done, then it is strongly recommended that the participation of students and laymen continue to be encouraged for this was the motive behind the original idea of an intercollegiate trip. Then the spring field trip, operated annually by the Academy's Section C, might maintain a more professional aspect if so desired.

C. N. SAVAGE, *Kent State University.*

EIGHT NEW LEAFHOPPERS FROM THE UNITED STATES (HOMOPTERA: CICADELLIDAE)

DOROTHY J. KNULL

Department of Zoology and Entomology, The Ohio State University, Columbus 10

Four *Erythroneura* of the Obliqua Group from Ohio, two *Orocastus* and a *Laevicephalus* from the southwest, and an *Athysanella* from South Dakota are included in this paper.

Erythroneura ampla n. sp.

Figures 18, 19

In the Obliqua Group, characterized especially by long straight posterior point of style and broad-based aedeagus, in lateral view, without processes.

Ground color semihyaline to yellowish white with orange markings. Vertex with orange inverted U enlarged on basal half toward but not touching eyes; continued across pronotum as two irregular vittae not reaching margins. Scutellum with basal angles yellow, tip orange. Elytra with usual oblique stripes, apices slightly infuscated near crossveins. Venter stramineus.

Genitalia. ♂ style with short foot, heel projecting slightly, anterior point almost rectangular, posterior point heavy, longer than base, straight, narrowed to sharp tip. Aedeagus in lateral view very broad on basal half, half as broad as long, narrowed on ventral half to rounded tip.

Length: 2.8. mm.

♂ holotype and 6 paratypes, Delaware Co., Ohio, March 25, 1945; 3 paratypes, April 30, 1944; 1, April 8, 1945; 1, May 29, 1945; 1, Hocking Co., April 11, 1945. All collected by D.J. & J.N. Knull and in collection of writer.

Erythroneura enata n. sp.

Figures 16, 17

Near *E. eluta* McAtee but with shorter blunt-tipped aedeagus with minute ventral projection.

Robust, short, ground color yellowish white anteriorly, whitish semihyaline elytra with bright orange vittae. Inverted V of vertex and arms continued across pronotum broad; basal angles of scutellum yellow outlined with orange and tip orange. Usual vittae of elytra distinct, apical cells faintly fumose. Below yellowish white, orange markings on face.

Genitalia: ♂ style with medium foot, base gently curved; heel sharply projecting; posterior point as long as base, sharp, thick; anterior point less than right angle, projecting a little. Aedeagus of medium size, in lateral view parallel-sided, gently curved dorsad toward rounded apical keel, a minute projection before opening of shaft on ventral portion of aedeagus.

Length: 2.8. mm.

Described from ♂s from Ohio collected by D.J. & J.N. Knull and placed in collection of author and of The Ohio State University. Holotype and 14 paratypes, Delaware Co., March 25, 1945; 1, May 11; 5, April 8, 1945; 1, Sept. 29, 1945; 1, Greene Co., April 28, 1949; 1, Highland Co., June 6, 1945: 4, Hocking Co., April 11, 1945: 2, Scioto Co., June 10 and 1, June 17, 1944: 2, Put-in-Bay, Sept. 18, 1945: and 1, Hartwick St. Park, Mich., July 17, Mary Auten, Collector.

Erythroneura freta n. sp.

Figures 12, 13

Near *E. stulta* Auten & Johnson and *E. obliqua* (Say) but aedeagus broad and straight in lateral view without processes.

Background color white with red-orange vittae. Inverted V of vertex with arms broadened toward eyes, continuations of arms on pronotum broad and not touching either margin; scutellum with basal angles pale orange, tip bright red-orange. Vittae of elytra broad, apical cells fumose,

and three dusky rounded spots before crossveins. Below creamy white with orange markings on face.

Genitalia: ♂ style with heavy foot, base curved, heel slightly projecting, posterior point as long or a little longer than base, thick, blunt; anterior point less than right angle, projecting slightly. Aedeagus in lateral view with dorsal keel curved very slightly dorsad, broad and narrowed only a little from base to apex.

Length: 2.9 mm.

Six ♂'s, holotype and paratypes, Delaware Co., Ohio, March 25, 1945; 2, April 30, 1944, D.J. & J.N. Knull collectors, in collection of writer.

Erythroneura tolerata n. sp.

Figures 14, 15

Near *E. infinita* Beamer and *E. penobliqua* Beamer but with aedeagus in lateral view with long slender apical fin and pair of processes arising well below base on ventral portion of aedeagus.

Background yellowish white to semihyaline on elytra, with anterior markings pellucid orange, to bright orange oblique stripes on elytra. Inverted V of vertex with arms broad toward eyes; continued across pronotum forming broad-based, irregular U; basal angles and tip of scutellum orange. Dark elongate spot in apex of anteapical cell next to costa. Below yellowish white with orange markings on face and a few dark spines on posterior femora.

Genitalia: ♂ style with medium foot, base straight, heel almost rectangular, posterior point not as long as base, sharp, straight; anterior point rectangular. Aedeagus long and slender, in lateral view, ending in long, narrow dorsal fin below opening, almost ⅓ as long as shaft, curved gently dorsad and with transverse tip. A pair of fine ventral processes arises half-way between base and opening, follows close to shaft and curves out slightly, not quite as long as shaft. Dorsal surface irregular near middle.

Length: 3.2 mm.

♂ holotype, Hocking Co., Ohio, October 19, 1945, and paratype, May 12, 1947, D.J. & J.N. Knull, in collection of writer.

Athysanella kadokana n. sp.

Figures 1, 2, 3

Near *A. salsa* Ball and Beamer in character of inner ♂ genitalia, but differing in genital characters in both sexes.

Vertex depressed medially, margins broadly rounded, bluntly produced, not as long as width between eyes. ♂ spur on hind tibia almost as long as first tarsal segment.

Color stramineus, varying from immaculate to heavily marked specimens. Usually a curved dash near ocellus and dots on abdomen more or less distinct; large black patches appear on pygofer, one either side of middle just below margin of last dorsal segment; face with seven or eight fine, dark, incomplete arcs and brownish longitudinal median streak either side of fine pale center line; sutures black; venter of abdomen and valve dark.

Genitalia: ♂ pygofer broad, almost rectangular, lower dorsal half heavily spinose; valve obtusely rounded; plates broadly rounded, extending beyond valve more than its median length. Styles projecting very slightly, finger-like process heavy, curved, parallel-sided, apex truncate, not narrowed as in *A. salsa*, base very heavy, triangular, broad flat outer surface pressing against plate. Aedeagus of medium length, in lateral view broad, almost parallel-sided, apex with hook

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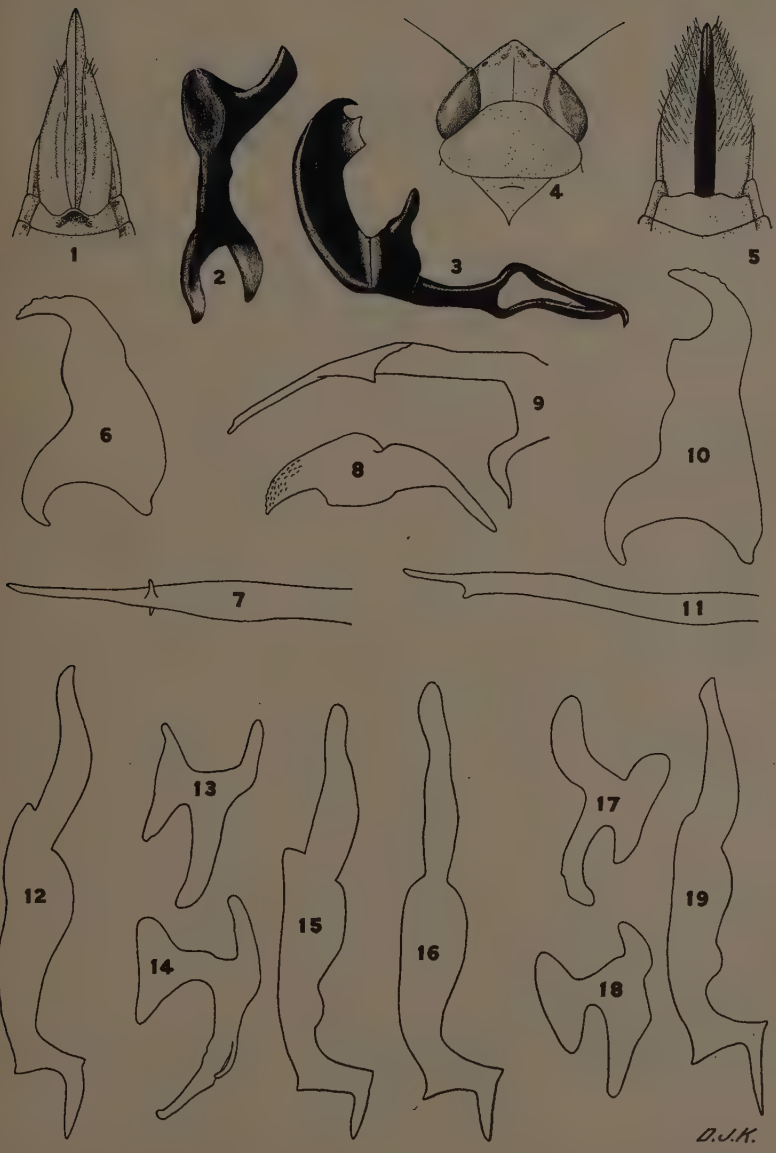
EXPLANATION OF PLATE

1, 2, 3. *Athysanella kadokana* n. sp. ♀ genitalia; ♂ style and aedeagus.
4, 5, 8, 9. *Laevicephalus vafer* n. sp. ♂ head; ♀ genitalia; ♂ style, and aedeagus.
6, 7. *Orocastus omani* n. sp. ♂ style and aedeagus.
10, 11. *Orocastus aurarius* n. sp. ♂ style and aedeagus.
12, 13. *Erythroneura freta* n. sp. ♂ style and aedeagus.
14, 15. *Erythroneura tolerata* n. sp. ♂ aedeagus and style.
16, 17. *Erythroneura enata* n. sp. ♂ style and aedeagus.
18, 19. *Erythroneura ampla* n. sp. ♂ aedeagus and style.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D.J.K.

on ventral tip and broad truncate portion below hook separated by circular space. ♀ last ventral segment with lateral lobes of posterior margin of medium size, projecting very slightly, median portion roundly produced almost as far as lateral lobes, darkened before margin. Great variation is found in the form of this segment.

Length: ♂ 3.3 mm.; ♀ 4.5 mm.

Holotype ♂, allotype and numerous paratypes of both sexes from Kadoka, S.D., Badlands, July 19, 1950, H.C. Severin, Collector. Types in collection of The Ohio State University, South Dakota State College, University of Kansas, and U.S. National Museum.

I am indebted to Dr. R.H. Beamer for examination of specimens and his opinion, and to Dr. H.C. Severin for the privilege of describing *A. kadokana*.

Orocastus omani n. sp.

Figures 6, 7

In Dr. Oman's description of the genus *Orocastus* he mentioned an undescribed species from Arizona. Specimens collected in southern mountain areas of Arizona sent to him proved to be this species, and together with the National Museum material collected by Dr. Ball, are described and named for Dr. Oman.

Small, golden yellow with veins toward apex lighter, eyes dark. Head wider than pronotum, roundly produced, not as long as pronotum. Elytra long, greatly exceeding abdomen.

Genitalia: ♂ valve small, sinuately triangular, narrower than last segment at base, plates long, narrowed near middle, produced to rounded tips, exceeded by pygofer by a third combined length; pygofer setose, row of setae on sides of plates. Dark oblique dashes either side of apex of valve are the feet of styles showing through plates. Underside of spines of hind tibiae and claws dark. Aedeagus V-shaped, basal portion at least half length of shaft. In lateral view shaft long, straight dorsally, ventrally broader near base and center, narrowed to slender blunt tip on outer fourth, a pair of minute sharp lateral processes projects laterad at right angles to shaft just before shaft narrows. Style with slender outcurved foot with four or more blunt teeth and narrow toe.

Length: 2.8 mm.

Described from ♂ specimens taken in late summer in mountains of southern Arizona. Holotype and 14 paratypes, Patagonia, August 7, 1950; 5, August 20, 1940; 2, Tumacacori Mts., August 7, 1950; 2, Huachuca Mts., August 12, 1950; 1, Santa Rita Mts., August 16, 1940, D.J. & J.N. Knull, in collection of The Ohio State University. Paratypes collected by Dr. E.D. Ball in U.S. National Museum: Nogales, 8, August 16, 1937; 1, August 15, 1937; 2, August 14, 1935; 1, July 29, 1933; 1, July 30, 1937; Santa Cruz River, 8, August 14, 1935; Benson, 3, August 9, 1937; 1, Far Away Ranch, August 11, 1937.

Orocastus aurarius n. sp.

Figures 10, 11

Indistinguishable from *O. omani* Knull except through characters of inner ♂ genitalia.

Slightly larger than *O. omani*. Aedeagus with base V-shaped, more than half as long as shaft, slightly sinuate and parallel-margined in lateral view, narrowed abruptly and hollowed out ventrally to less than half its width and produced in a long, narrow dorsal keel, twice as long as width before notch. Style heavier than in *O. omani* with toe more bluntly produced and with five or six blunt teeth on outer margin.

Length: 3 mm.

3 ♂'s, holotype and paratype, Davis Mts., Texas, August 2, 1937; and Chiricahua Mts., Ar., August 28, 1940, D.J. & J.N. Knull, in The Ohio State University Collection.

Laevicephalus vafer n. sp.

Figures 4, 5, 8, 9

Somewhat similar in general appearance to *L. acus* (S. & DeL.) but ♀ with last ventral segment not as produced and aedeagus in ♂ with large diamond-shaped process on shaft near middle.

Elongate, head as wide as pronotum, right angled, not quite as long as pronotum. Pale buff with orange tinge on head, pronotum and scutellum. Vertex with median impressed line,

ocelli, arcuate line from apex toward eye and short dash before base either side nearer eyes than middle, brown. Trace of longitudinal stripes on pronotum in some specimens, scutellum pale. Elytra milky semi-hyaline, veins lighter, yellow margined dark segments of dorsum showing through. Face brown with five arcs and center buff, sutures dark, venter pale laterally, dark medially, ovipositor dark.

Genitalia: ♀ last ventral segment bisinuate on outer margin, very slightly produced, area above ovipositor finely, longitudinally striate, and semihyaline. ♂ plates elongate, narrowed on outer half to fine, blunt tips, not as long as triangular pygofers. Aedeagus in lateral view long, straight, and broad on basal half, with broad triangular enlargements extending laterad from ventral surface, forming large diamond in ventral view, apical half less than half width of basal, and bent dorsad at about 45° angle. Styles elongate, narrowed on outer half with blunt tip covered with bucculae on outer portion.

Length: ♂ 3.5 mm.; ♀ 3.8 mm.

♂ holotype, allotype and 3 ♀ paratypes, Huachuca Mts., Arizona, Sept. 9, 1938, D.J. & J.N. Knull, in collection of The Ohio State University. 8 ♀ paratypes, Santa Rita Mts., Arizona, Sept. 21, 1935, E.D. Ball, in U.S. National Museum.

Dr. P.W. Oman and Dr. R.H. Beamer examined the Huachuca Mts. specimens and considered them undescribed.

The May Number of the Ohio Journal of Science contained

THE GLACIAL BORDER —
CLIMATIC, SOIL, AND BIOTIC FEATURES

A Symposium of the Ecological Society of America held at Columbus, Ohio, September 13, 1950, during the Meeting of Biological Societies sponsored by the American Institute of Biological Sciences.

E. Lucy Braun, *Chairman*

Vegetation and Cryoplanation ..... *Hugh M. Raup*

Pleistocene Frost Action Near the Border of the Wisconsin Drift in Pennsylvania ..... *Charles S. Denny*

The Fossil Record Near the Glacial Border ..... *J. E. Potzger*

The Possible Role of Microclimate ..... *John N. Wolfe*

Animals of the Glacial Border ..... *Edward S. Thomas*

Plant Distribution in Relation to the Glacial Boundary ..... *E. Lucy Braun*

Copies of the May Number containing the papers in the Symposium may be obtained from the Business Manager of the Journal at $1.00 each. Reprints of the revised and expanded paper by E. S. Thomas, "Distribution of Ohio Animals," will be sent without additional expense to all who order the May Number.

A NEW SILVERFISH OF ECONOMIC IMPORTANCE FOUND IN THE UNITED STATES (THYSANURA: LEPISMATIDAE)

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Thysanura (silverfish) have been infesting the basement rooms of the Main Library on the Ohio State University campus for at least twenty years. Since 1947, the writer has made repeated collections of silverfish from this infestation. Among approximately 500 specimens taken, none was *Lepisma saccharina* Linnaeus, one was *Thermobia domestica* (Packard), and the rest were of the genus *Ctenolepisma* Escherich, species unknown.

The name chosen for this new species is to honor Dr. F. L. Campbell, former Professor of Entomology at Ohio State University.

Ctenolepisma campbelli n. sp.

Figures 1–10

Female (fig. 1) Length: Body, 8 mm. Antennae, 8 mm. Cercus, 6 mm. Median caudal filament, 9 mm. Ovipositor as seen from below, 1 mm. Stylus (D), 0.5 mm. Thorax equals half of body length. Width: Body, 2 mm. Abdomen equals thorax in width. Thoracic segments weakly arched. Abdominal segments I-III taper outward posteriorally at their lateral margins. Segments V-VIII taper inward posteriorally at their lateral margins. Color: Body, nearly transparent. Dorsal surface with silvery grey scales. Ventral surface with nearly white scales. Appendages, transparent. An inconspicuous reddish granular pigment occurs in all appendages. Pigment more conspicuous in dried specimens. Cerci and median caudal filament with non-pigmented segment at intervals. Dorsal setal combs occur on the caudal margins of the 3 thoracic tergites, 1 comb on each side (A). Setal combs occur on the lateral margins of abdominal tergites I-VIII, 1 comb on each side (B). Setal combs occur on the caudal margins of abdominal tergites II-VI, one comb on each side (C). One pair of styli (D). Compound eyes with 12 ommatidia.

Setae on medial setal areas of the head (E) arranged in straight orderly widely spaced rows (fig. 2).

Distal segment of the labial palpus (fig. 3) nearly equal in length to the penultimate one and with 5 large elongate sensory papillae (F).

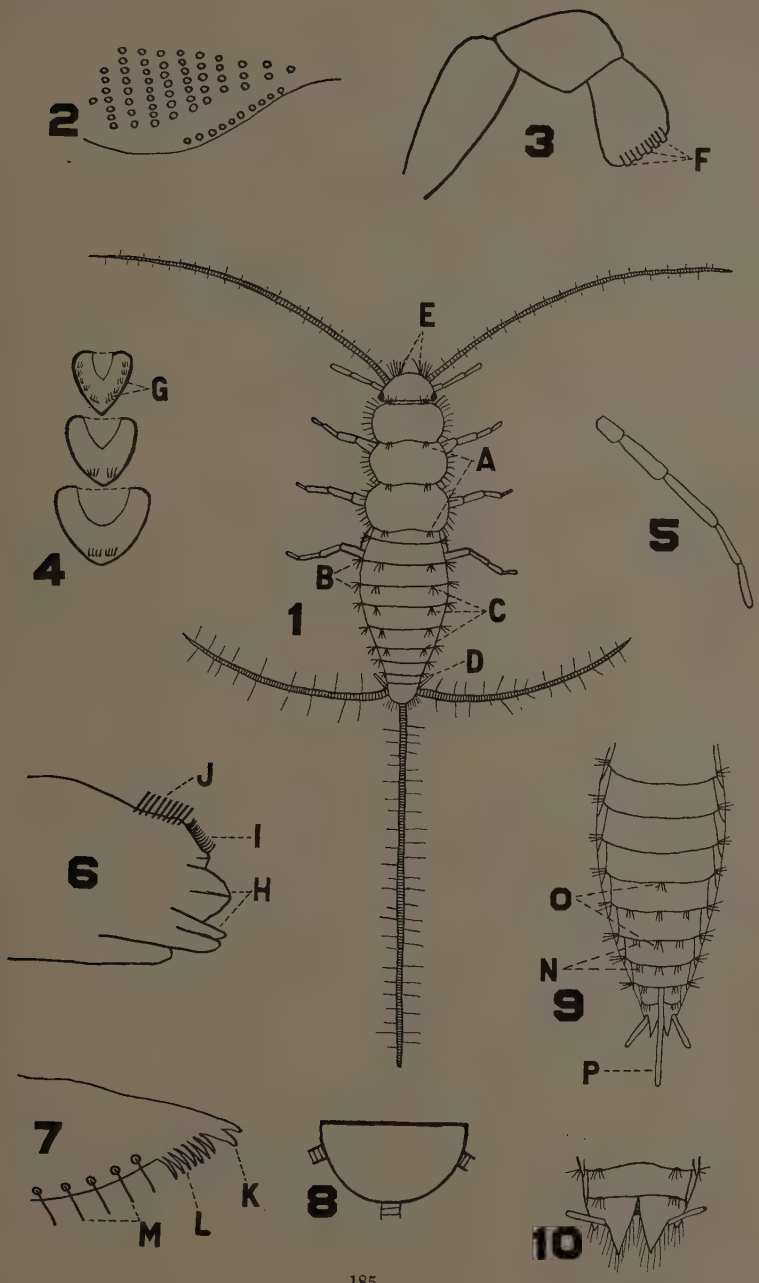
Thoracic sternal plates (fig. 4) heart shaped. Prosternal plate with 5 pairs of setal combs (G). One pair of setal combs occurs on each the mesosternal plate and the metasternal plate.

Maxillary palpi (fig. 5) 5-segmented.

EXPLANATION OF FIGURES

Ctenolepisma campbelli n. sp.

1. Entire insect, dorsal view. A, thoracic tergal setal combs. B, abdominal lateral tergal setal combs. C, abdominal inner tergal setal combs. D, stylus. E, medial cephalic setal area.
2. Medial cephalic setal area showing arrangement of setae.
3. Labial palpus. F, sensory papillae.
4. Thoracic sternal plates. G, setal combs.
5. Maxillary palpus.
6. Mandible. H, heavily sclerotized teeth. I, marginal comb with about 20 curved teeth. J, 8 or 9 fused setae.
7. Lacinia. K, heavily sclerotized tooth. L, comb-like structure having 7 teeth. M, 5 setae arising from distinct alevoli.
8. Tergite X.
9. Female abdomen, ventral view. N, sternal setal combs. O, medial setal combs. P, ovipositor.
10. Sternites IX and X of the male abdomen.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Mandible (fig. 6) with 2 heavily schlerotized teeth (H) followed on the inner margin by a comb-like structure with about 20 closely set curved teeth (I) followed by 8 or 9 heavy setae (J) each apparently formed by the fusion of 2 closely set setae into one.

Lacinia (fig. 7) terminated by a single bifurcate heavily schlerotized tooth (K) followed on the inner margin by a comb-like structure with 7 transparent teeth of uniform size (L) followed by 5 widely spaced setae (M) set in distinct alveoli.

Tergite X (fig. 8) rounded with length equal to combined lengths of tergites VIII and IX.

Setal combs occur on the caudal margins of abdominal sternites V-IX (fig. 9) one on each side (N). Setal combs occur on the mid-ventral line on abdominal sternites IV-VII (O). Ovipositor extending beyond segment X and visible from above (P).

Male (fig. 10) about one-fifth smaller than the female and otherwise like the female except for differences in genitalia and the appearance of abdominal sternite IX.

This species differs from *Ctenolepisma urbana* Slabaugh, *Ctenolepisma quadriseriata* (Packard), and *Ctenolepisma longicaudata* Escherich by the number of styli and the body length of mature individuals. *C urbana*, *C quadriseriata*, and *C. longicaudata* measure 15, 15, and 14 mm. body length as adults and have 2, 3, and 2 pairs of styli respectively while *C. campbelli* measures a maximum of 8.5 mm. in body length and has only 1 pair of styli.

This species can be easily mistaken for immature stages of *C. longicaudata* since *C. longicaudata* acquire the second pair of styli in the 11th instar for the female and in the 9th instar for the male. In both species the medial setal tufts of the head are arranged in definite widely spaced rows and both species lack emargination of tergite X. They may be readily differentiated since *C. campbelli* has only 5 sensory papillae on the labial palpus while the *C. longicaudata* palpus has from 9 to 12 sensory papillae.

Holotype female. Columbus, Ohio, January 1951, from The Ohio State University Main Library. *Allotype* and *paratypes* from the same locality. *Holotype*, *allotype*, and *paratypes* (one male, one female) deposited in the collection of The Ohio State University Department of Zoology and Entomology Museum, Columbus 10. Also *paratypes* (one male, one female) sent to each of the following: The United States National Museum, Washington 25, D. C., The Illinois Natural History Survey Museum, Urbana, Illinois, and The Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

REMARKS

Shipments of books from other parts of the world are stored in the basement rooms of the library where this species was found. This suggests a possible introduction from some other country. *C. campbelli* is well established in this library building and is apparently spreading to other locations. This species has been collected by the writer in the library and basement of one other campus building and from an apartment house over 2 miles away.

The importance of this insect economically is similar to the other domestic species of Lepismatidae. The damage to books is largely to the covers. In the O. S. U. infestation only a few books are seriously damaged. Often a newly captured insect will show colored intestinal contents corresponding to the color of the book cover on which it recently fed.

The writer is pleased to acknowledge assistance from Miss Grace E. Glance of The United States National Museum Staff and Dr. Charles L. Remington, Osborn Zoological Laboratory, Yale University, New Haven 11, Connecticut, who both kindly examined specimens.

STUDIES OF THE GENUS *KUNZEANA*. I. FIVE NEW SPECIES OF MEXICAN *KUNZEANA*

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Department of Zoology and Entomology, The Ohio State University, Columbus 10

While working with the *Dikraneurini* complex of the Cicadellinae, Oman has separated out a genus which he has named *Kunzeana*. *D. kunzei* Gillette was designated as the type. Although closely related to *Dikraneura* it is distinguished from it by the venation of the wings. The outer apical cell is much shorter in *Kunzeana*, not extending basad of the adjoining apical cell. It differs from *Dikrella* in having an inner apical cell narrower basally than the combined width of the two adjoining apical cells.

The species of this genus occur in the southwestern portion of the United States and in Mexico. The Mexican fauna is especially abundant in species and most of the species are undescribed. The first group of undescribed species are treated below. The types of all these species are in the DeLong collection.

Kunzeana popae n. sp.

Figure 5

Resembling *kunzei* (Gillette) in general form and appearance but larger, with a shorter head, and with distinctive coloration and genitalia. Length 3.25 mm.

The vertex of the male is produced about one-half of its length in front of the eyes. The anterior margin is bluntly angled at the apex and its median length is about two-thirds as great as its basal width between the eyes. The vertex of the female is slightly longer and more sharply angled than that of the male.

Color: The vertex is orange-yellow with a dull creamy band extending along the anterior margin between the eyes. The face is dusky tan with the lorae and genae creamy-yellow. The pronotum is olive-green with a broad, orange-yellow band along its anterior margin. This anterior band of the pronotum is produced onto the disk as blunt points near the middle of each side. The scutellum is dull orange with its basal angles orange. The elytra are translucent yellowish-green with semi-hyaline stripes along the clavus next to the claval suture, between the medial and cubital veins, and along the distal third of the costal margin.

Genitalia: The posterior margin of the seventh abdominal sternite of the female is almost truncate with its lateral margins rounded. The ovipositor projects but little beyond the pygofers. The plates, styles and pygofers of the male are similar to those of *kunzei*. The long, thin pygofer hooks arise at the base of the anal tube. They are directed ventrad at their bases, then bend sharply caudad near their proximal third and taper evenly to sharp points. The base of the aedeagus is short. The dorsal processes of the base are moderate in length and taper to sharp apices. The phalicata curves gently dorsad and is moderately thick and broad. It expands laterally near its apex and then narrows to a sharp apex. A pair of long, thin, sharply pointed lateral processes arise near the base of the phalicata and extend proximal to the phalicata to near its apical third. There, they diverge slightly laterally and terminate near the expanded portion of the phalicata. In caudal view, a second pair of lateral processes can be seen. These arise slightly below the first pair and extend proximal to the phalicata for almost their entire length, only their curved, pointed apices diverge from the phalicata.

Holotype male and allotype female collected at Mt. Popo, Mex., Sept. 28, 1941; male and female paratypes collected at Puebla, Pue., October 18, 1941, and at Orizaba, V. C., Oct. 17, 1941, (K 280), by DeLong, Good, Caldwell and Plummer; male and female paratypes collected at Mexico City, D. F., (W. 18kms.), Sept. 1, 1939, by D. M. DeLong; male paratype collected from corn at Santa Barbara, Mex., May 12, 1927, (M. B. 224), and from corn, May 28, 1927, (M. B. 226), by Dr. Dampf.

Kunzeana popae var. **jacintae,** n. var.

Similar to *popae* in general appearance and genitalia, but differing from it in being slightly larger, having the head more rounded at the apex, and having different coloration. Length 3.5 mm.

The vertex is similar to that of *popae* with the exception of the anterior margin which is definitely more rounded at the apex than that of *popae*. The male genitalia of *popae* and *jacintae* are alike while the posterior margin of the seventh abdominal sternite of the female of *jacintae* is more produced at the middle than that of *popae*.

Color: The vertex is orange-red with an ivory band along the anterior margin between the eyes. The face is dusky orange with the lateral portions of the genae cream. The pronotum is olive-green with an anterior band similar to that of *popae*, orange-red. The scutellum is dusky-orange with the apex and basal angles orange-red. The elytra are translucent, bright to orange-yellow. The hyaline stripes on the clavus and corium of the male are broader than those of *popae* while the female of *jacintae* has only the first and fourth apical cells semi-hyaline.

Holotype male from San Jacinta, D. F., May 24, 1932, (M. F. 2566); allotype female same locality June 30, 1932 (M. F. 2601); male paratypes from San Jacinta June 23, 1932 (M. F. 2589); May 16, 1932 (M. F. 2551); June 7, 1932 (M. F. 2579); Chapingo, D. F., May 19, 1924 (M. B. 54) all collected by Dr. Alfonse Dampf. The San Jacinta specimens were collected at a light trap. The Chapingo specimens were swept from *Shinus molle*.

Kunzeana acaciae n. sp.

Figure 4

Resembling *popae* in general form and appearance but with distinctive coloration and genitalia. Length 3.5 mm.

The vertex is produced for about one-half of its length in front of the eyes, the anterior margin is bluntly angled at its apex, and its median length is about two-thirds as great as its basal width between the eyes.

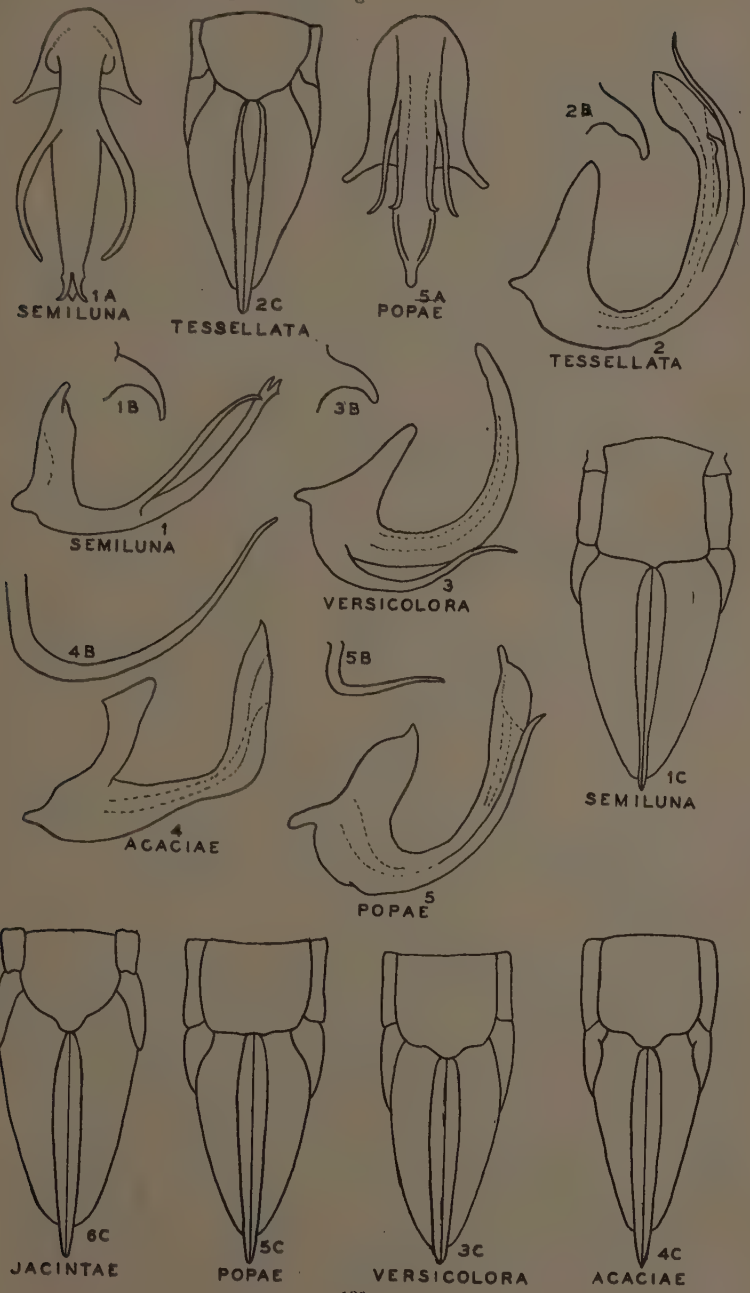
Color: The vertex is golden-brown in the male, orange-brown in the female, with an ivory band along the anterior margin between the eyes. The face is dusky tan with the genae and lorae cream. The pronotum is olive with an orange-red band along its anterior margin. This orange-red band projects as sharp points onto the disk near the middle of each side of the pronotum. The scutellum is nearly uniformly orange. The elytra are translucent green to golden-yellow.

Genitalia: The lateral margins of the seventh abdominal sternite of the female are nearly straight and slope inwardly to a truncate median portion, the middle half of which is again produced into a blunt lobe. The ovipositor is but little produced beyond the pygofers. The plates, styles, and pygofers of the male are similar to those of *popae*. The thin pygofer hooks arise near the base of the anal tube and curve dorso-caudally. They are sharply pointed and subequal in length to the aedeagus. The base of the aedeagus is short and narrow with the dorsal processes of the base moderately long, thin, and erect. The phallicata is bent at nearly right angles near its center with the proximal portion directed caudo-dorsally and the distal portion directed dorsally. In lateral view, the proximal portion tapers evenly inwardly to the bend. There the ventral margin is expanded and then tapers evenly again to its pointed apex.

Holotype male, allotype female and male and female paratypes collected from a white flowered, creeping acacia at Las Casas, Chiapus, July 2, 1926, (M. F. 1015) by Dr. Dampf; male paratype collected at Tetela del Rio, G'ro., Aug. 13, 1930, (M. F. 1757) by J. Parra; male and female paratypes collected at Rio Frio, D. F., Oct. 7, 1941, (K 55) by DeLong, Good, Caldwell and Plummer; male paratype collected at Valles, S. L. P., Mex., Dec. 1, 1938, by J. S. Caldwell.

EXPLANATION OF PLATE

1, 2, 3, 4, 5. Aedeagus (lateral view).
1A, 5A. Aedeagus (ventral view).
1B, 2B, 3B, 4B, 5B. Pygofer hook (lateral view).
1C, 2C, 3C, 4C, 5C, 6C. Female seventh sternite and pygofers.


1A
SEMILUNA
2C
TESSELLATA
5A
POPAE
2B
2
TESSELLATA
1B
1
SEMILUNA
3B
3
VERSICOLORA
4B
4
ACACIAE
5B
5
POPAE
1C
SEMILUNA
6C
JACINTAE
5C
POPAE
3C
VERSICOLORA
4C
ACACIAE

Kunzeana tessellata n. sp.

Figure 2

Resembling *popae* in general form and appearance but with the anterior margin of the vertex more rounded at the apex and with distinctive coloration and genitalia. Length 3.25 mm.

The vertex is produced about one-half of its length in front of the eyes, with its anterior margin rounded, and with its median length about two-thirds as great as its basal width between the eyes.

Color: The vertex is light cream to dull tan heavily spotted with flecks of red which merge in places to form chains. A large, round, orange spot is located on each side of the vertex near the apex and a large cream spot is located near the middle of each side of the anterior margin. The dorsal portion of the face is dark cream flecked with red while the lower portion is dull tan with the lorae and genae cream. The disk of the pronotum is light greyish-green with its anterior margin broadly bordered by a dull, creamy band which is heavily flecked with red. The scutellum is dull orange with the basal angles and apex yellowish-orange. The elytra of the male are dull yellowish-orange while those of the female are dull greyish-red.

Genitalia: The posterior margin of the seventh abdominal sternite of the female is decidely produced, its lateral margins are straight and slope inwardly to a median portion which is angled at its apex. The ovipositor exceeds the pygofers but little in length. The plates, styles, and pygofers of the male are similar to those of *popae*. The bluntly pointed pygofer hooks arise on the dorso-caudal angle of the pygofers, extend caudally, and have a slight point near the middle of their ventral margins. The base of the aedeagus is moderately short and narrow with the dorsal processes of the base long, thin, and erect. The phalicata extends gently dorsad and is nearly parallel-sided to its bluntly pointed apex. A pair of thin, sharply pointed ventro-lateral processes arise near the middle of the phalicata and extend parallel to the phalicata to a distance slightly above its apex. These processes are closely appressed to one another for their entire length. A second pair of processes arisé on the sides of the phalicata near its middle, diverge slightly from the phalicata, and extend to near its apex. These processes are thin, their apices are sharply pointed, and their apical portions are recurved.

Holotype male, allotype female, male and female paratypes collected at Puebla, Pue., Oct. 18, 1941, by DeLong, Good, Caldwell and Plummer.

Kunzeana versicolora n. sp.

Figure 3

Resembling *tessellata* in general form and appearance but with distinctive coloration and genitalia. Length 3.25 mm.

The vertex is produced about one-half of its length in front of the eyes, the anterior margin is bluntly angled at the apex, and its median length is about two-thirds as great as its basal width between the eyes.

Color: The vertex is a light greyish-white flecked with spots of red which join in places to form irregular lines. A large, orange spot is located on each side near the apex of the vertex and a large white spot is located on the anterior margin near the middle of each side. The face is light tan with the genae and lorae cream. The center of the disk and the posterior margin of the pronotum are golden orange. The remainder of the pronotum is greyish white flecked and irregularly-lined with red. A few large, orange spots are located along the anterior margin of the pronotum. The scutellum is dusky orange with the basal angles and the apex a lighter orange. The elytra vary in color from translucent, sordid green to smoky, tinted with red. This variation in color is independent of sex and locality.

Genitalia: The posterior margin of the seventh abdominal sternite of the female is but little produced, its lateral margins are nearly straight, and its median portion is keeled. The ovipositor exceeds but little the pygofers. The plates styles, and pygofers of the male are similar to those of *tessellata*. The thin pygofer hooks arise on the dorso-caudal angle of the pygofer, are sharply pointed, and curve gently ventrally. The base of the aedeagus is moderately long and narrow with the dorsal processes of the base sharply pointed and moderately long and thin. A pair of thin, recurved, sharply pointed, closely appressed ventro-lateral processes arise on the base and

extend caudally to near the middle of the phalicata. The thin phalicata curves gently dorsally and tapers evenly to a sharply pointed apex.

Holotype male, allotype female, male and female paratypes collected at Mexico City, D. F., (W. 18 kms.), Sept. 1, 1939, by D. M. DeLong; male and female paratypes collected at Mexico City, D. F., Toluca Rd., Sept. 26, 1945, by DeLong, Hershberger and Elliott.

Kunzeana semiluna n. sp.

Figure 1

Resembling *popae* in general form and appearance but with distinctive genitalia. Length 3.25 mm.

The vertex is produced for about one-half of its length in front of the eyes, it is bluntly angled at its apex, and its median length is one-half as long as its basal width between the eyes.

Color: The vertex is golden brown with its anterior margin bordered by a thin, cream band. The face is golden brown with the genae and lorae greyish-ivory. The pronotum is pale olive with its anterior margin bordered by a golden brown band which is produced onto the disk as a sharp point near the middle of each side. The scutellum is dull orange with the basal angles a lighter orange. The elytra are translucent bright yellow with a broad stripe along the claval suture, the apical third of the costal margin, and the apical cells, semi-hyaline.

Genitalia: The posterior margin of the seventh abdominal sternite of the female is nearly truncate with its lateral angles sharp and with its median quarter produced into a sharply pointed lobe. The plates, pygofers, and styles of the male are similar to those of *popae*. The pygofer hooks arise near the base of the anal tube, are directed caudo-ventrally, and taper from a heavy base to a sharply pointed apex. The base of the aedeagus is moderately long and slender with its dorsal processes rather short. The phalicata is long, thin, and broad, and is curved slightly dorsad. A pair of long, thin lateral processes arise on the proximal third of the phalicata and then curve back toward it. These processes terminate near the apex of the phalicata. A pair of very short, flat, recurved ventral processes arise on the phalicata near its apex and terminate at the apex of the phalicata.

Holotype male, allotype female, and female paratype collected at La Guarda, D. F., (Km 40), October 26, 1941 by DeLong, Good, Caldwell, and Plummer.

Static and Dynamic Electricity. *William R. Smythe.* McGraw-Hill, New York. Second Edition, 1950. xxi+616 pp. $8.50.

The second edition of this unusual book follows the general plan of the first edition. It is written for graduate students and designed especially for the experimental physicist and electrical engineer rather than for the theoretical man. This accounts for the omission of topics of historical interest and those which have no practical applications. Theories of electrolytic conduction, thermionic emission, photoelectric phenomenon, and thermoelectric effects have likewise been omitted; the author felt that a treatment of them on a comparable level with the other material included in the text would require too extensive a knowledge of physical chemistry.

An understanding of the calculus, differential equations, and vector analysis is presumed. Other mathematical tools are developed as needed. The book strives to enable the student to solve the unusual field problems which continually arise in present day research by going back to first principles. As an aid in accomplishing this mission, the text includes over 700 problems which in many cases extend the material covered in the text. The range of difficulty in the problems is so great that no average student could solve them all. In reference to the problems on electro-magnetic waves, the author states "every problem was solved by at least one advanced student."

Although unconventional in both its contents and approach to the subject the text represents a very significant contribution to the literature on electricity and magnetism. The chapters on electromagnetic radiation, wave guides, and cavity resonators appear very timely. Much of the material in these chapters cannot be found elsewhere in such a complete and concise form.

Additional features include the use of the rationalized mks units and in so far as possible the new approved American Standard letter symbols. A good bibliography at the end of each chapter and a complete index increase the value of the book for reference purposes.

All branches of knowledge change so rapidly today that predictions are dangerous. However, in another decade, probably this book will be considered a classic in its range.

E. S. Foster, Jr.

A SIMPLE MICRO-VIEWING APPARATUS

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Department of Zoology-Entomology, Alabama Polytechnic Institute, Auburn

The micro-viewing apparatus described in this paper was devised to facilitate the histological analysis of food habits material collected from the cottontail rabbit, *Sylvilagus floridanus mearnsi*. In this food habits research the fecal pellets

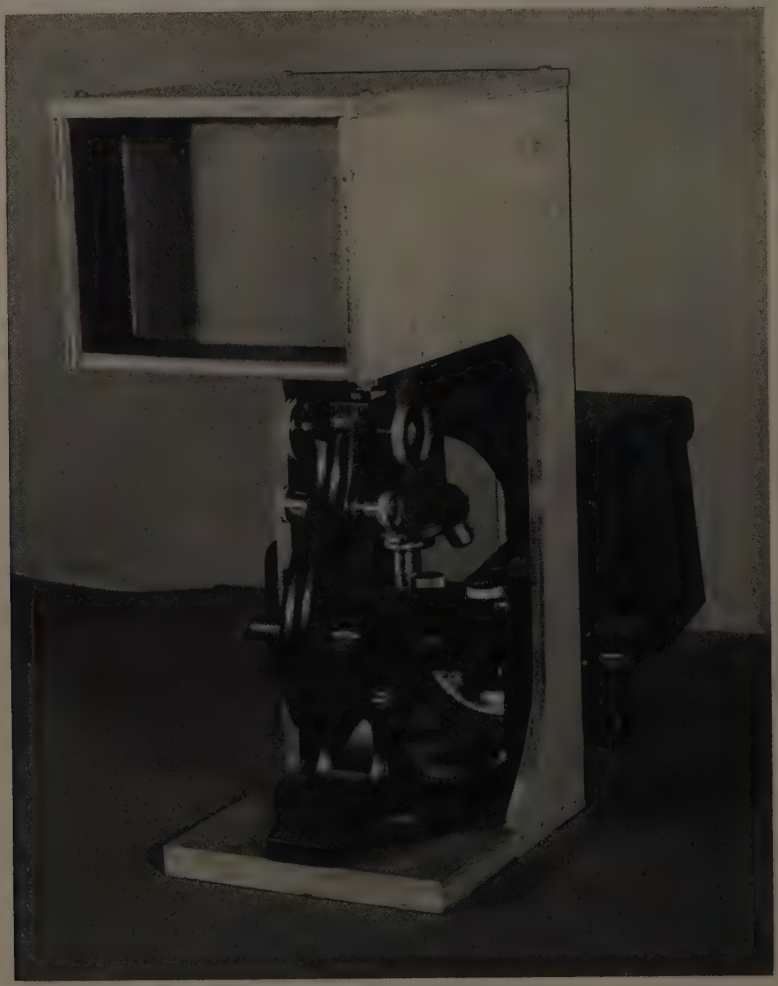

FIGURE 1. The Micro-viewer.

[1]This research was done while the writer was a research fellow of the Ohio Cooperative Wildlife Research Unit, Ohio State University, Columbus, Ohio.

of the rabbits were collected. The plants the rabbit had eaten were determined by histological identification of the particles of plant epidermis which were found in the pellets. Nearly 200 samples were collected. Therefore the project required much time to be spent in making microscopic analyses. As a result, eyestrain problems were encountered. The micro-viewing apparatus was designed primarily as a means for reducing them.

The pellet samples each consisted of fine particles of plant tissue. These were mounted on a microscope slide under a coverglass so that they could be viewed using transmitted light. The method of analysis was to view each particle on the slide, identify the material, and record the determination.

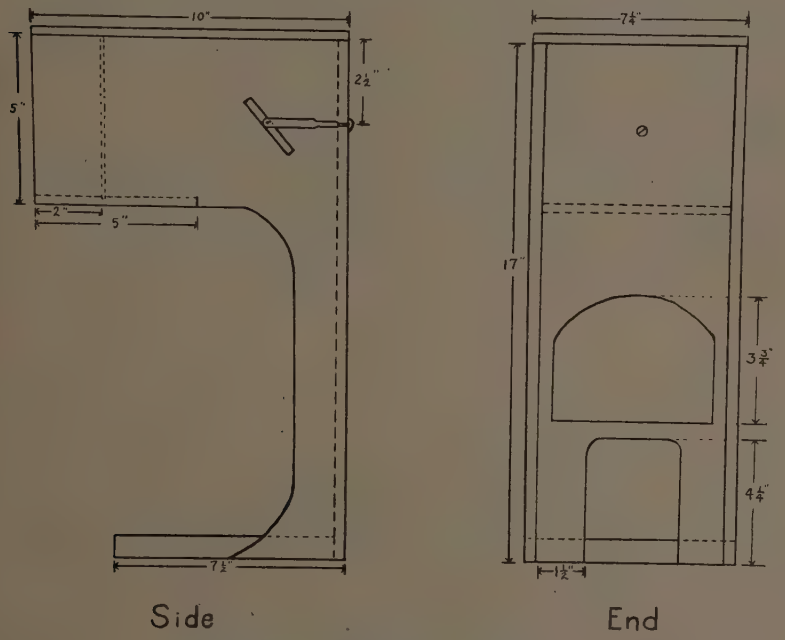

FIGURE 2. Drawing of the micro-viewer.

To do this, a mechanical microscope stage was used for orientating the material. Approximately one-half hour was required for each sample. Both monocular and binocular compound microscopes were used. In each case severe eyestrain resulted after working for more than an hour. The eyestrain was caused chiefly from the accommodation necessary in the frequent upward and downward focusing of the microscope. Eyestrain from use of the monocular microscope was more severe than that resulting from use of the binocular microscope.

The need for a means of avoiding this eyestrain was felt early in the project. It was reasoned that if the image were projected upon a plane surface, the strain of accommodation would be eliminated, since the eyes could focus on that single plane only, regardless of whether the image was in focus. This would also allow binocular vision.

The micro-viewing apparatus designed was very simple. The image from the ocular of a monocular compound microscope was reflected at right angles by a

microscope mirror mounted above it. The image reflected from the mirror was directed upon a 5 inch x 7 inch ground-glass. The opposite side of the ground-glass was the viewing screen. This apparatus was mounted in a housing so that a person seated in front of the viewer could sit in an upright position and manipulate the viewer with ease (figs. 1 and 2).

The only other necessary apparatus was a good research microscope lamp such as used in photomicrography, and a rheostat for controlling the intensity of illumination.

It is realized that many refinements could be made in this viewer, such as substituting a prism for the microscope mirror and a less granular screen in place of the ground glass. The latter would be necessary if analyses were being made that required extremely good definition. Use of this viewer reduced eyestrain sufficiently to permit work periods to be lengthened greatly.

Although this micro-viewer was designed to solve the eyestrain problems encountered in food habits research, there are other applications for which it would seem quite valuable. It would seem quite useful for demonstrating microscopic specimens to a small group of students. In many instances it would be more valuable than a comparison eyepiece for instructional purposes. In situations where a limited number of microscopes are available, this device might be an aid in increasing the number of students per microscope. Undoubtedly if the reader does much microscopic work, he will be able to apply this micro-viewer to many other situations.

Introduction to Geography. *Henry M. Kendall, Robert M. Glendinning, and Clifford H. MacFadden.* Harcourt, Brace and Company, New York. 1951. xii+752 pp. $6.25.

The authors have been prompted by a two-fold purpose in presenting their text to college students: "To lay an adequate foundation for those continuing the study of geography and to serve as a thorough survey of place differences throughout the world for those who will have little or no further contact with college geography." Both aims have been fully realized in a simple yet professional style. All citizenry could, through its study, become more cognizant of the problems and patterns of others which should lead to better understanding of human attitudes and actions.

The presentation consists of a four-part plan: Part I (three chapters), introduces the field and tools used; Part II (fifteen chapters), acquaints the reader with the nature and distribution of the elements of the physical environment; Part III (ten chapters), directs attention to the nature and distribution of the cultural elements; and Part IV (two chapters), presents regional concepts and changing patterns.

Useful material on maps, climate, and population follows in the appendices. Most chapters are followed by chapter outlines, review questions, and suggested references which enterprising teachers and students can use advantageously. Although primarily designed for two semesters, cutting may provide a workable one-semester course.

Attractively arranged, the book contains topographic maps on inside cover pages, nine world maps in full color, and uses a two-column format. Over 450 maps, diagrams, charts, sketches, and photographs should aid greatly in holding student interest. Truly a well-balanced book which should have a good reception.

HARRY K. HUTTER.

EFFECT OF INSECTICIDES UPON EARTHWORM POPULATIONS

J. B. POLIVKA

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Earthworms are familar to almost everyone. Some people consider them objectionable when they are apparent in their lawns and in golf courses, particularly on the putting greens, while others consider them beneficial in aerating and pulverizing the soil. For this reason the first group, composed largely of greenkeepers and homeowners, is interested in methods for their control, whereas the second group is interested in control measures which will destroy all of the other soil pests without reducing the earthworm population.

The chemicals recommended for the control of the earthworms have little effect upon the control of white grubs that may be present in the soil. On the other hand it has been generally considered by many people that the insecticides which are applied for the control of grubs will also destroy the earthworms.

This paper presents data which were taken from plots that were used to study the effect of various insecticides upon the control of the Japanese beetle larvae.

In the first experiment, which was established upon sandy soil in Bratenahl, Ohio, the soil was treated with lead arsenate on September 24, 1941, by broadcasting the material by hand without using any diluent. The insecticide was applied at various levels to plots of 10 by 20 feet with each level replicated five times.

TABLE 1

Effect of lead arsenate upon the earthworm population of Bratenahl, Ohio

RATE OF LEAD ARSENATE IN LBS. PER 1000 SQ. FT.	EARTHWORMS PER SQ. FT.			
	May 28, 1942	Percent reduction	May 21, 1943	Percent reduction
5.0	24.3	7.6	29.2	4.3
7.5	24.3	7.6	24.8	18.7
10.0	14.5	44.9	17.8	41.7
12.5	17.3	34.2	12.2	60.0
15.0	15.0	43.0	16.7	45.3
Untreated	26.3	.....	30.5	.....
L.S.D. at 5% level =	12.1	.....	15.2	.....

The rates at which the lead arsenate was applied are shown in table 1. All plots were examined for earthworms in May of 1942 and again in May of 1943 by taking four cores of soil of ¼ square foot surface area and to the depth of 8 inches.

In the second experiment which was also established upon sandy soil but in Newburgh Heights, Ohio, lead arsenate and DDT were applied to the soil on October 2, 1945. These materials were mixed with milorganite and distributed by means of a flour sifter. All treatments were replicated five times and each plot consisted of 100 square feet.

The insecticides and the rates at which they were applied are shown in table 2. In these plots the total earthworm count was taken on October 16, 1950, or approximately 5 years after the insecticide applications were made.

TABLE 2

Effect of lead arsenate and DDT upon the earthworm population in October, 1950, when applied October 2, 1945, to soil in Newburgh Heights, Ohio

Toxicant	Rate of technical material per acre in pounds	Earthworms per square foot	Percent reduction
		Oct. 16, 1950	
Lead arsenate	500.0	46.8	12.0
DDT	12.5	47.4	11.9
DDT	25.0	52.0	2.3
DDT	37.5	30.2	43.2
Untreated	....	53.2	....
L.S.D. at 5% level	....	21.5	....

L.S.D. = least significant difference.

RESULTS

In the first experiment, when the plots were examined on May 28, 1942, none of the lead arsenate plots was significantly lower in earthworm population than the untreated plots. When the plots were examined a year later or on May 21, 1943, the 12.5 pound rate seemed to have caused a significant reduction in earthworm population. However, inasmuch as the values obtained for all other treatments were not significantly different from those of the untreated plots the significance indicated for the 12.5 pound level must have been due to error in sampling.

In the second experiment the highest level of DDT used (37.5 pounds per 1000 square feet) resulted in earthworm populations that were significantly lower than those in untreated areas but the margin of significance was slight. In no other treatment did the difference in earthworm population following insecticide treatment approach significance.

The results of these experiments indicate that applications of lead arsenate and DDT to the soil, in the amounts given and for the time intervals noted, had little if any effect on the density of earthworm populations.

Workbook for Weather Forecasting. *E. S. Pulk and E. A. Murphy.* Prentice-Hall, New York. First edition, 1950. 66 pp. plus a map series kit. $3.75.

Instruction in meteorology has long been handicapped by lack of suitable laboratory manuals. With the publication of this workbook the authors fortunately have produced a worthwhile addition to the list of useful manuals.

The first three chapters deal with plotting exercises. Regular teletype transmissions of weather data are included for the preparation of surface, upper air, and adiabatic charts. Blank charts and maps as well as sample breakdowns of the coded data enable the student to decipher the codes himself. In the last three chapters, the student is introduced to the techniques of analysis commonly used by forecasters. Non-technical discussion of air mass and frontal analysis, and correct interpretation of constant pressure level and adiabatic charts make this book a valuable teaching aid. The appendix which includes only a short glossary, a few formulas and scales, and a list of meteorological texts could be expanded.

Pulk and Murphy's manual will help to simplify a rather difficult subject although a companion text is needed which will take some of the mathematical gobbledygook out and give the student some insight into the actual problems the practicing forecaster must face.

LYLE REXFORD FLETCHER.

A DEVICE FOR REARING ANIMALS REQUIRING A FLOWING WATER ENVIRONMENT

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The usual method of rearing animals that live in flowing water is to place them in screened cages either partially or completely submerged in a stream. This method has several drawbacks: cages are subjected to destruction by floods and inquisitive humans, no provisions can be made for temperature and food controls, and more specifically, the screen reduces the velocity of water inside the cage. In order to simulate stream conditions as much as possible without the difficulties mentioned, a "stream-tank" has been devised.

With this equipment, a free flowing current of water is provided in which objects may float continuously. It provides methods for controlling the velocity of the water and the height of the water level, and it is a self-contained unit which facilitates the feeding of specimens contained therein. This equipment was designed specifically to study the effects of flowing water on mosquito larvae, but with a few modifications, it might be used in work with other species of animals living in flowing water.

In this stream-tank, water is drawn from a reservoir and pumped, through two distributing arms which terminate in special nozzles, into the main channel of the tank to produce the water flow. The rate of introduction of water into the main channel, which is regulated by a valve, regulates the rate of flow of the water in the tank. Velocities up to four feet per second may be obtained in the stream-tank. As the water is pumped into the channel, drainage takes place underneath a separating wall between the main channel and a narrower secondary channel, and from this secondary channel the water drains by gravity through drain gates back into the reservoir, from which it is recirculated. The drain gates are adjusted to provide an *exact balance* between the rate of drainage and the rate of pumping into the tank; thus a continuous flow of water is produced and a constant water level is maintained.

DETAILS OF CONSTRUCTION

The stream-tank was constructed from the writer's original drawing by a furnace repairing establishment and the materials used were 24 gauge galvanized iron, copper screening, solder, and rivets.

The main channel is 8 inches wide and has a center circumference of 14 feet. The outer side wall is 10½ inches high and will permit water depths up to 9 inches. A flat plastic ruler may be attached to the wall of the main channel to enable reading water levels at a glance. In order to retain mosquito larvae in the channel and to avoid a congregation of the larvae at any central drainage point, a secondary channel of 4 inches was added. The galvanized iron separating wall between the two channels was placed ⅛ inch off the floor of the tank, being retained in position by L-shaped metal brackets on the bottom. Several separator strips (10)[2], 4 and 8 inches long were placed over the tops of the channels to retain the regular oval shape of the tank (fig. 1). The 4 inch strips were permanently fastened,

[1]Research Fellow, Ohio State University Research Foundation, National Institutes of Health Project, U. S. P. H. S. The writer wishes to thank Professors C. E. Venard, D. M. DeLong, D. J. Borror, R. W. Powell and I. P. Blauser of the Ohio State University for valuable assistance during the course of this work.

[2]The numbers in parentheses refer to details illustrated usually in both figures 1 and 2.

while the 8 inch strips are removable to permit rapid cleaning of the tank. Ten evenly spaced ports were cut in the bottom of the separating wall to provide additional drainage. A port consisted of two 1 inch cuts about 3 inches apart with this 3 inch flap bent toward the main channel. Gravel (8), approximately

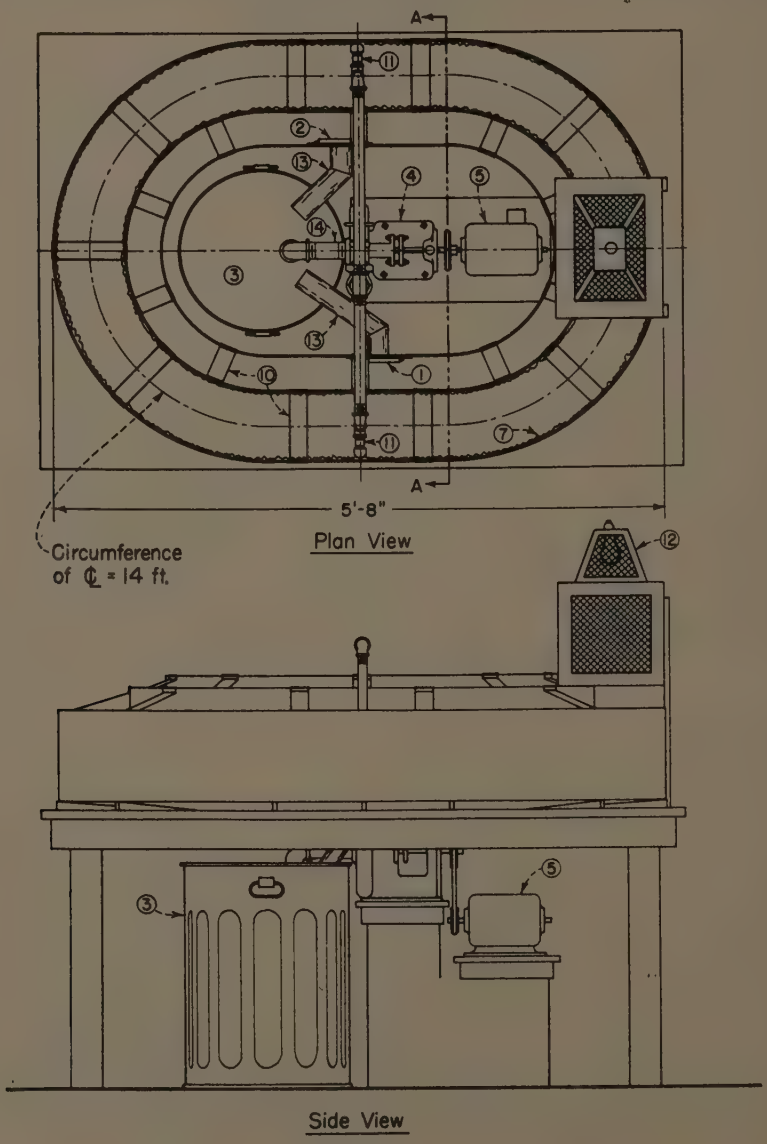

FIGURE 1. The stream-tank. (Drawn by Clyde Kearns.)

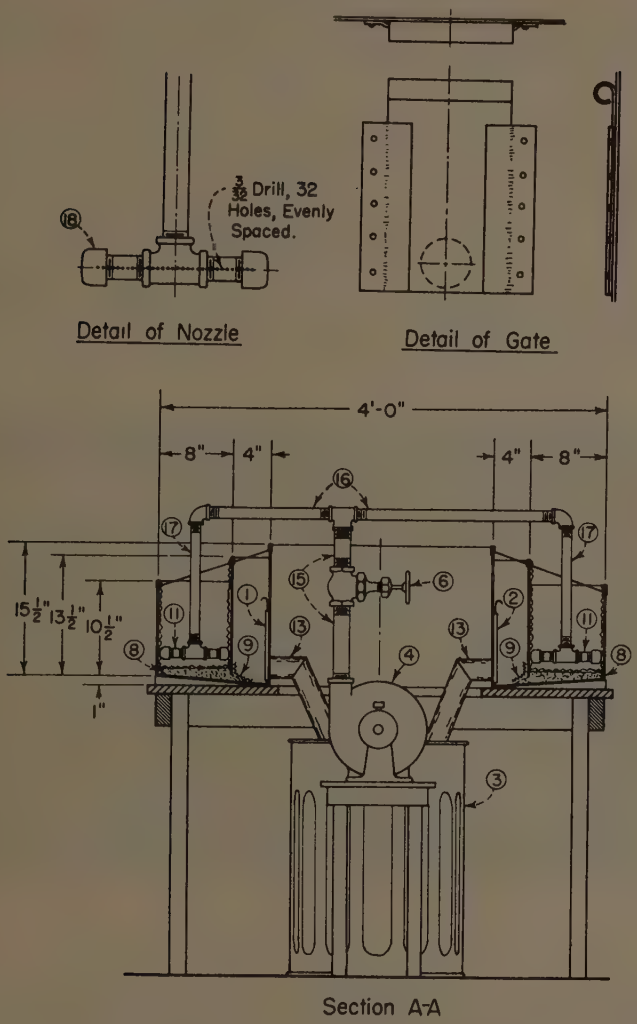

FIGURE 2. The stream-tank. (Drawn by Clyde Kearns.)

KEY TO NUMBERS SHOWN IN THE PLATES

1, 2. Drain gates.
3. Reservoir.
4. Pump.
5. Motor.
6. Globe valve.
7. Organdy cloth.
8. Gravel.
9. Copper screening.
10. 4″ and 8″ Separators.
11. Nozzles.
12. Mosquito cage.
13. Drain pipes.
14. Suction pipe.
15. Discharge pipe.
16. Distributor pipe, 1″.
17. Distributor pipe, ¾″.
18. ¾″ Galvanized iron caps.

¼ inch in diameter, was put in the main channel to a depth of 1 inch to diffuse drainage. To retain the gravel in the main channel, 16-mesh copper screening (9) was soldered to the bottom of the tank and the bottom of the separating wall on the secondary channel side.

The addition of organdy fabric (7) to the sides and bottom of the main channel was required because the larvae would disappear amidst the gravel. The organdy was cut to pattern, sewed together into a U-shaped shell, and held in position by strips of metal 1 inch x 20 inch, bent U-shaped and inverted in the main channel.

The drain pipes (13) were attached directly on the bottom of the wall toward the center of the equipment, and carried the water to the reservoir (3), which had a 32 gallon capacity. To assist in the drainage, the entire tank was mounted on metal bases that forced a 1 inch downward slope of the bottom toward the reservoir which is in the center of the equipment. This arrangement (fig. 2) permitted a continuous flow of water of constant depth to circulate in the main channel and a sufficient drain-off of water without causing a congregation of larvae at any single point or points.

FIGURE 3. Detail of stream-tank. This view shows the motor, pump, valve and drain pipe as seen from above.

The centrifugal pump (4) used has a rated capacity of 67 g.p.m. at 1725 r.p.m. This type of pump was chosen because of the uniform flow it produces. The electric motor (5) used to drive the pump is rated at 1 hp. and 3450 r.p.m., and to obtain the proper speed for the pump, a 2 inch pulley was placed on the motor and a 4 inch pulley on the pump (fig. 3). The pulleys were of the Vee-type, and a 32 inch belt was employed to connect the two pulleys. The stream-tank, the pump, and the motor were all mounted on substantial wooden tables made of 2 inch x 4 inch lumber with the top of the table supporting the tank made of ¾ inch material. The supports for the pump and motor were nailed together as one piece and it was made completely free of the table for the tank in order to eliminate excessive vibration of the tank by the pump and motor.

The galvanized pipe required to carry the proper volume of water to the pump was 1½ inches in diameter (14). A 32 inch length of this pipe was used to draw the water from the reservoir; it was connected to the pump by a 4 inch section and

an elbow. On the discharge side of the pump, an 8 inch section of 1¼ inch pipe was used (15). Connected directly to this section was the 1¼ inch globe valve (6). Another 4 inch section of 1¼ inch piping was employed coming out of the valve. A 1 inch x 1 inch x 1¼ inch reduction tee was placed on the last section of 1¼ inch pipe to reduce the piping to 1 inch. At the discharge end of each 1 inch distributing pipe (16), a 1 inch to ¾ inch reduction elbow was fitted. Each downward distributing arm from these elbows was ¾ inch pipe (17). The nozzles (11) were formed by joining two nipples to a ¾ inch tee and placing caps (18) at each end. Thirty-two evenly spaced holes were drilled across the entire face of the nozzles, including the tee and both caps (fig. 2). The bore of the holes was 3/32 inch, and the length of the nozzles when assembled was 7½ inches.

In order to retain any emerging adults in the stream-tank, marquisette netting was taped to the separating wall and pulled over the main channel, where it was fastened with clothes pins (fig. 4). To facilitate observations on the water level and the specimens in the stream-tank, several sections of celluloid were taped over cut-out portions of the netting. In conjunction with this netting, a regular

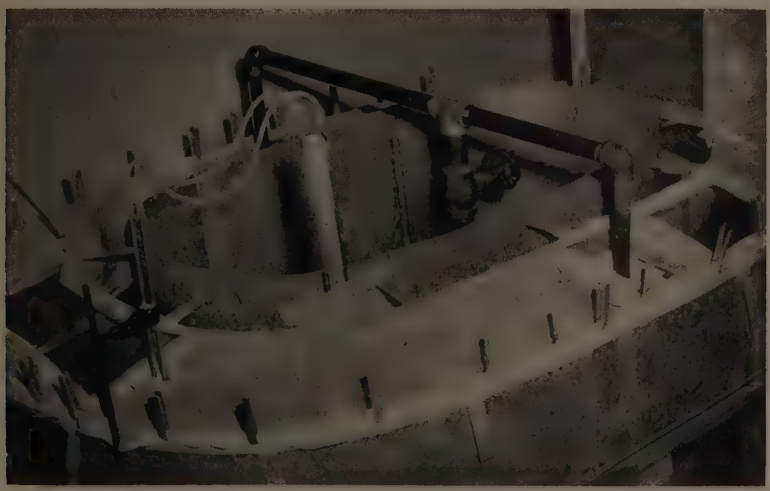

FIGURE 4. The stream-tank. This view gives the over-all plan of the stream-tank. The flow of water was clockwise.

mosquito cage 12 inches x 16 inches x 11 inches (12) was placed over one end of the tank with the bottom cut out to fit the curve of the main channel. More marquisette was taped around the free spaces between the tank and the cage. In order to attract the adults, a 60-watt bulb was placed over the cage. When the room was dark, the bulb was turned on. However, when all the lights were on during the day, the cage was darkened to attract the adults. The adults were removed from the cage by inserting a masonite bottom, then suctioning them out of the sleeve side of the cage.

OPERATION OF THE STREAM-TANK

To place the stream-tank in operation, drain gates (1, 2) were closed and the reservoir one-half filled with water by means of a garden hose. As soon as this was completed, the hose was quickly transferred to the secondary channel, filling the main channel indirectly to avoid disturbing the bed of gravel. When the

desired water level was reached in the main channel, the hose was removed. The entire system contains 65 gallons of water when the tank level is 5 inches and the reservoir half full.

The pump was primed and the motor started. Drain gate (2) was opened slightly and the globe valve (6) opened enough to cause the desired velocity in the main channel. The velocity was measured by using a Pitot tube or by measuring the speed of a floating object in the main channel. After the desired velocity was reached, drain gate (1) was raised or lowered until the desired water level was obtained. The ruler guide was watched for a period of time to be sure that the water level was maintained.

When cool tap water was introduced into the system, the equipment was allowed to run for several hours until the water temperature was stabilized. If the air temperature was constant, the water temperature would remain constant, but it would remain several degrees higher than the air temperature.

DISCUSSION

The stream-tank has been operated for a period of six months and has worked satisfactorily, but several details remain to be smoothed out. Better control of drainage could probably be obtained by replacing the gate type valve with a globe type valve. The organdy fabric deteriorates after six weeks of constant usage. A search is being conducted for a more resistant fabric. Nylon fabric is currently being tested and shows some promise.

In some respects the stream-tank does not exactly simulate stream conditions. The cross section of the main channel is rectangular, while a stream cross section is somewhat curved; the stream-tank channel may be altered by placing the gravel in the bottom of the tank and arranging it to obtain the desired curvature. The water velocity in an actual stream varies from zero at the point of contact with the stream bank to a maximum several inches below the surface at midstream; the velocity of water in the stream-tank is always greatest at midstream and greater at the outer periphery than at the inner periphery.

Introduction to Electricity and Optics, *Nathaniel H. Frank.* McGraw-Hill Book Co., New York. Second Edition, 1950. xv+440 pp. $5.00.

The material in this volume covers a wide field for an elementary course although the text is intended for the second year of a two-year introductory course in Elementary Physics. More than two-thirds of the book deals with electric and magnetic effects, making it comparable to many intermediate texts in Electricity and Magnetism. Extensive use is made of the calculus and to a more limited degree, vector notation and algebra. These represent the simplest approach to advanced problems and it is well that the student becomes accustomed to thinking along these lines as early as possible.

The author employs the rationalized mks system of units throughout the main body of the text. This is a desirable change, since engineering texts and many advanced physics texts on electricity now deviate from the traditional electrostatic and electromagnetic systems of units. Appendix I contains a section on the various systems of units offering sufficient source material so that a student can read literature on the subject of traditional units without difficulty. An outstanding feature of the text is Chapter I on "Fields of Force," which should prove very valuable in orienting the student.

The treatment of Physical Optics is adequate and a little above the normal level in Introductory Physics texts. The approach to Geometrical Optics and Optical Instruments compares essentially with that included in any Engineering Physics text. It is regrettable that a subject such as Geometrical Optics should be slighted so universally in text books for the sake of the more spectacular physical optics.

The problems offered in the text are good and numerous enough to permit rotation of assignments from year to year.

E. S. Foster, Jr.•

THE CHIGGER PROBLEM IN CITY LAWNS WITH SUGGESTIONS FOR THEIR CONTROL

DWIGHT M. DeLONG AND JAMES F. SMITH

Department of Zoology and Entomology, The Ohio State University, Columbus 10

For several years the chigger, *Trombicula alfreddugesi* (Oudemans), has been a common pest problem in city lawns in various parts of Ohio, particularly in the southern half of the State. Columbus is one of the portions that is heavily infested. A brief survey has shown chiggers are common on lawns in all parts of the city and calls come in daily during the summer season for help in controlling them.

Persons of all ages may subject themselves to the attacks of chiggers in various ways. Such daily tasks as mowing or sprinkling the lawn, or hanging freshly laundered clothing on a line are the easy ways to become infested. Youngsters crossing the grass at play or engaged in various games upon the lawn are often heavily attacked. Occasional gatherings around a picnic table on the rear lawn seems to be a common source of infestation.

Because of the urgent and continuous request for assistance, the writers carried out a series of replicated tests during July, August, and September using some twenty lawns to determine the relative merits of some of the more recently developed insecticides.

Over a period of years previous to 1950, nicotine in different forms, pyrethrum, and various forms of sulphur were used upon the lawns but without successful control. Azobenzine was found to give excellent control when it was first available in experimental quantities but it never became a widely distributed commercial product and could not be recommended for general use. During the summer of 1949, Benzine hexachloride at a 1% gamma strength gave adequate control of chiggers but was not considered successful because of the odor which accompanied the treatment and continued for several weeks thereafter.

Among the several materials that were used in these tests, the best results were obtained by Chlordane, Lindane, and Dimite. Lindane 20% emulsifiable material was used at the rate of 2½ pints per 100 gallons of water as a lawn grass and foliage application. This was at the strength of one part of Lindane to 1,600 parts of water. The amount used was approximately 1 gallon to 300 square feet of lawn or at the rate of 145 gallons per acre. Chlordane was used at about the same strength and rate. Dimite-di (p-chlorophenyl methyl carbinol) was used at the rate of 1 pint of 25% emulsifiable strength to 100 gallons of water or at a 1 to 3,200 dilution. The same rate per acre was used as in the preceding materials. In each case repeated examinations indicated a complete chigger control for a period of at least six weeks after application, in some cases where applications were made sufficiently early in the season eight weeks control was obtained. In all cases the treatment remained effective until normal seasonal chigger activity had ceased. The treated lawns were compared through the season with the untreated lawns bordering them to determine the length and degree of infestation during the period the treated lawns were under observation.

Another problem should be considered. The shrubbery surrounding the lawn is often infested and persons may be attacked by reaching through or brushing against the shrubbery in order to reach a water faucet even though the grass has been entirely freed from chiggers. In these cases the shrubbery has also been treated in experimental tests.

Populations of chiggers are usually unevenly distributed and population size is difficult to determine. Two methods were used for checking presence or abun-

dance, the black paper method of Jenkins (1947), and the human "guinea-pig" method.

In view of the fact the larvae usually climb up and congregate on sticks or stumps and similar objects, pieces of black paper or board 5" x 8" if placed on edge in the grass for a short time will usually collect and show the presence of chiggers.

The most satisfactory method from the standpoint of lawns is to use the residents as guinea-pigs and see if they can pick up any chiggers while performing the customary tasks under which conditions infestations have been obtained prior to treatment. The possibilities of error and the influence of psychological factors were given due consideration in the data collected by this method.

In several cases where treatments were made, residents voluntarily agreed to subject themselves to more possible infestation in order to check the effectiveness of these materials. Also, parents examined youngsters carefully every day for newly attached chiggers in order to assist in determining the degree of control obtained in several specific cases.

REFERENCE

Jenkins, D. W. 1947. The ecology and laboratory rearing of chiggers affecting man in the United States (Acarina, Trombiculidae). Abstracts of Dissertations, The Ohio State University Press. p. 80.

World Resources and Industries. *Erich W. Zimmermann.* Revised edition. xvi+832 pp. Harper & Bros., New York. 1951. $7.50.

This revised edition, first since the initial publication in 1933, does honor to the meticulous care and persevering enterprise of an outstanding scholar and teacher in the field of world resources and industries. It is regrettable, however, that nearly twenty years elapsed before a revision was accomplished, especially in view of the need for a book of such outstanding merit.

The revision has been thorough and the material considerably expanded, with noteworthy emphasis on bringing the information up to date. Obviously a tremendous editorial task was undertaken in preparing the manuscript for publication but even a most cursory examination will reveal the commendable outcome.

The pattern or organization developed in the first edition has been closely followed in the revision. The numerous charts and diagrams are highly informative and well executed. Although the pictures represent a careful selection, unfortunately in several instances four are crowded onto one page whereby they lose much of their effectiveness. Listing of an excellent bibliography at the end of each chapter instead of a composite one at the back of the book, offers a decided improvement over the first edition. Smaller type and double columned pages appear in the revised publication.

Although the book reads easily its size plus the vast amount of information will most likely tend to restrict its use to students in the upper division and to those following graduate programs. In addition to the publication's selection for college and university classes interested in a study of world resources and industries, one may well expect that the majority of libraries will secure a copy of this excellent book.

The work will undoubtedly become a classic in the vital field of world resources and industries.

CURTIS M. WILSON.

The Principles of Heredity. *L. H. Snyder.* D. C. Heath and Company, Boston. Fourth edition, 1951. xi+515 pp. $4.75.

Genetics is a field in which new facts are discovered almost daily and old facts given fresh interpretations. The new fourth edition of this well-known, widely-used textbook will successfully introduce students to the new facts and concepts, and at the same time provide a firm foundation in the classical principles of Mendelian heredity.

The substance of the book remains unchanged except for details of wording and symbolism. New material includes a chapter on cytoplasmic inheritance, expansion of a chapter on biochemical genetics, and considerable expansion of the last three chapters on human genetics.

Outstanding for its clarity and readability, the book excells as a text for undergraduates in the principles of heredity.

E. L. GREEN.

A BRIEF HISTORY OF THE OHIO JOURNAL OF SCIENCE[1]

GLENN W. BLAYDES

Department of Botany and Plant Pathology, The Ohio State University, Columbus 10

The November 1950 issue of THE OHIO JOURNAL OF SCIENCE marked the fiftieth anniversary of this publication. The contents of the fifty volumes of THE OHIO JOURNAL OF SCIENCE is a fine record of the achievements in science by scientists at the Ohio State University and throughout Ohio, over a period of half a century. In November 1900 the first issue of the OHIO STATE UNIVERSITY NATURALIST was published as the official organ of the Biological Club of the Ohio State University. This organization has continued to the present as the Biology Club. With the publication of the third issue, the name was shortened to the OHIO NATURALIST. In 1903 the Ohio Academy of Science accepted the Naturalist as its official organ. In 1912 the name was again changed to the OHIO NATURALIST AND JOURNAL OF SCIENCE. Numerous important papers in the fields of biology were published in the Naturalist and have been widely cited.

In 1915 the science departments of the University organized the Ohio State University Scientific Society, with the Biological Club as a section of this organization. The Biological Club proposed that the OHIO NATURALIST AND JOURNAL OF SCIENCE be made more comprehensive to represent and serve more adequately the various areas of science in the University. The title was changed to THE OHIO JOURNAL OF SCIENCE, and responsibility for its publication was vested in the O. S. U. Scientific Society. The development of several science organizations in various areas resulted in reduced interest in the Scientific Society, when in 1927 it ceased to function. Control of the JOURNAL went to the Ohio Journal of Science Board of the Ohio State University. This arrangement continued until 1932 when a closer relationship between the JOURNAL and the Ohio Academy of Science was established. Arrangements were made for THE OHIO JOURNAL OF SCIENCE to be controlled jointly by the Ohio Academy of Science and the Ohio State University. The control of the JOURNAL was placed under the Joint Administrative Board. This Board consisted of four members, two appointed by the Ohio Academy of Science and two by the Ohio State University. This arrangement has continued successfully to the present time. Members of the Board are Dr. Edmund M. Spieker, Chairman, and Dr. Bernard S. Meyer, as representatives of the University, and Dr. Wilbur M. Tidd, the Ohio State University, and Dr. R. A. Hefner, Miami University, electives of the Ohio Academy of Science.

THE OHIO JOURNAL OF SCIENCE is published bimonthly, with the six issues of a year appearing during the months of January, March, May, July, September, and November. Scientific papers are accepted for publication from Academy members or non-members in all fields of science. The last volume contained 306 pages, made up of 46 papers contributed by outstanding research scientists in the fields of Anthropology, Bacteriology, Botany, Chemistry, Conservation, Ecology, Engineering, Entomology, Genetics, Geography, Geology, Medicine, Ornithology, Physiology, and Zoology.

The circulation of THE OHIO JOURNAL OF SCIENCE is at present nearly 1700 copies. Of this number, 1200 go to the membership of the Ohio Academy of Science. Foreign exchanges amount to about 250; domestic exchanges to about 150. The publications received in exchange are deposited in the Ohio State University Library. A conservative estimate of the value of these exchanges is $1800.00 annually. Each issue of THE OHIO JOURNAL OF SCIENCE is mailed to 439 libraries,

[1]Department publication 533.

THE OHIO JOURNAL OF SCIENCE 51(4): 205, July, 1951.

mostly those of colleges and universities in the United States and 79 foreign countries distributed in Asia, Europe, South America, and Africa.

The Ohio Journal of Science is financed by annual contributions from the Ohio State University, and by about an equal amount from the Ohio Academy of Science. The Academy contributes $1.50 from the annual dues of each member. Some additional funds are obtained from the sale of reprints and back numbers, and starting during the past year, from solicited advertising.

On January 1, 1951, Dr. Earl L. Green of the Department of Zoology and Entomology became Editor-in-Chief, succeeding the writer. Dr. Richard A. Popham of the Department of Botany and Plant pathology is Business Manager, with Dr. Richard H. Böhning, of the same department, as Advertising Representative. Dr. Curtis M. Wilson of the University of Toledo is in charge of book reviews.

MEMBERSHIP IN THE O. A. S.

Membership in the Ohio Academy of Science is open to all persons interested in science.

The officers and members of the Ohio Academy of Science extend a cordial invitation to membership to residents of the state, non-residents, laymen interested in science, teachers, college students, high school students, and professional scientists.

Members of the Academy are entitled to attend the annual meeting and field trips of the academy, to present the results of scientific research at the annual meeting, to view the exhibits of the Junior Academy and scientific supply companies, to attend the annual banquet, to vote in the business meetings, and to apply for grants-in-aid of research work from the Academy research fund. In addition each member receives, free of charge, all publications of the Ohio Biological Survey and an annual subscription to The Ohio Journal of Science.

A membership application card and a pamphlet of information relative to the Ohio Academy of Science will be supplied upon request. Please address

Dr. Rush Elliott,
Secretary, The Ohio Academy of Science,
Ohio University,
Athens, Ohio.

ANNUAL REPORT OF THE OHIO ACADEMY OF SCIENCE
1951

Organized 1891 Incorporated 1892
Affiliated with the American Association for the Advancement of Science

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W. C. BEAVER.....Term expires 1955

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   W. C. Beaver.....Term expires 1955
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L. R. Fletcher	Gordon Hendrickson	R. A. Popham	W. M. Tidd

REPORT OF THE SIXTIETH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

The sixtieth annual meeting was held on the campus of Miami University on April 5, 6 and 7. Many of the sectional programs were held in the newest building on the Miami Campus, Upham Hall. The attendance was about six hundred, almost 50% of the total membership of the Academy.

Each section presented a program, and two special field trips were arranged for Saturday, April 7, one in Conservation and another in Geology. The third Annual Science Day of the Junior Academy was extremely successful and was well attended.

The annual banquet and business meeting were held in the dining hall of Oxford College Residence Hall on Friday evening at 6:30. Dr. W. H. Shideler served as toastmaster and President E. E. Hahne extended greetings from Miami University. The response for the Academy was given by Dr. George B. Barbour. The presidential address was given by President E. S. Thomas on the title, "The Distribution of Ohio Animals."

The annual report of the past year's activities presented by the Secretary included a summary of membership, with the present membership being approximately 1,250. One hundred twenty-five new members were added during the past year.

The following persons were announced as newly elected Fellows of the Academy:

E. K. Alban	F. W. Fox	E. C. Myers
L. J. Alexander	H. H. Gray	Orlando Park
F. L. Berger	W. M. Gregory	J. Z. Pelton
N. D. Blackburn	E. R. Hayes	E. T. Price
R. H. Böhning	C. H. Heinke	Cecil Riser
J. C. Buford	H. K. Hutter	W. H. Shaffer
E. R. Caley	D. T. Jones	W. A. Spoor
D. R. Clippinger	W. F. Kieffer	G. C. Tague
Mildred Danklefsen	C. A. Lamb	C. S. Thornton
R. S. Davidson	L. L. Lowenstein	E. G. Weston
D. R. Dodd	W. R. McConnell	L. R. Wylie
Phillip Dye	R. E. McKay	E. K. Wilson
C. W. Ellett	C. S. Martin	

The report of the Nominating Committee was presented by Dr. R. J. Bernhagen, of the Necrology Committee by Dr. H. H. M. Bowman, and of the Resolutions Committee by Dr. H. R. Eggleston.

Respectfully submitted,

Rush Elliott, *Secretary.*

REPORT OF THE EXECUTIVE COMMITTEE AND COUNCIL

The Executive Committee met on December 7, 1950, and again on April 5, 1951, and the Council on December 8, 1950, and again on April 5, 1951.

As a result of three new types of membership provided last year by amendments to the Constitution, one affiliate membership, 8 corporation memberships and 15 institution memberships are now held in the Academy.

Many items relative to the normal operation of the Academy were considered at the meetings. The Council accepted with regret the resignation of Mrs. Margaret McCartney as Librarian for the Academy.

The Council authorized the appointment of a special committee to make plans for and initiate preparations for the publication of an "Ohio Flora." This committee (Dr. Lucy Braun, chairman; Dr. Glenn W. Blaydes, Dr. Charles A. Dambach, Dr. J. Arthur Herrick and Dr. John N. Wolfe) presented a report and recommended steps to be followed in the production of such a work. A committee is being appointed to carry on this project.

The 1952 annual meeting is to be held at Kent State University on April 17, 18, and 19.

Respectfully submitted,

RUSH ELLIOTT, *Secretary.*

REPORT OF THE TREASURER

COLUMBUS, OHIO, April 5, 1951.

To the Ohio Academy of Science:

I submit herewith a financial statement of the condition of the Ohio Academy of Science as of December 31, 1950. The books have been audited and the opinion of the auditor is herewith attached.

Respectfully submitted,

ROBERT M. GEIST, *Treasurer.*

OHIO ACADEMY OF SCIENCE STATEMENT OF INCOME AND EXPENSE

For the year ending December 31, 1950

CURRENT EXPENSE FUND

INCOME:		
Membership dues 1950 and prior years	$3,512.50	
Sale of Publications	28.21	
Interest on U. S. Savings Bonds	47.50	
Miscellaneous	3.50	
Total Income		$3,591.71
EXPENSES:		
Subscriptions—Ohio Journal of Science	$1,895.49	
Postage, Printing, Bank Charges, Office Expense, Auditing, etc.	1,414.86	
Total Expense		3,310.35
Excess of Income over Expenses		$ 281.36

RESEARCH FUND

INCOME:		
Interest on Bonds	$59.50	
Dividends on Stock	25.00	
Total Income		$ 84.50
EXPENSES:		
Bank Service Charges		1.28
Excess of Income over Expenses		$ 83.22

CASH BALANCES

CURRENT EXPENSE FUND:		
Cash Balance—January 1, 1950		$ 687.77
Net Cash Receipts		3,619.96
		$4,307.73
Less: Expenses		3,310.35
Cash Balance—December 31, 1950		$ 997.38
RESEARCH FUND:		
Cash Balance—January 1, 1950		$ 224.84
Net Cash Receipts		84.50
		$ 309.34
Less: Expenses		1.28
Cash Balance—December 31, 1950		$ 308.06

AUDITOR'S CERTIFICATE

January 31, 1951.

The Ohio Academy of Science, Columbus, Ohio.

GENTLEMEN:

In accordance with your request, we have made a detailed audit of the records of the Treasurer of The Ohio Academy of Science for the year ended December 31, 1950.

All cash receipts were traced to the bank and were found to have been deposited intact. Cancelled checks were on file for all disbursements and were examined. Cash balances were verified by certificates obtained from the banks.

The securities held in the two funds were verified by examination, and the income therefrom properly accounted for. The securities are held in a safety deposit box at the Huntington National Bank.

In my opinion, based upon such examination, the statements presented herewith present the financial condition of The Ohio Academy of Science as of December 31, 1950, and the transactions for the year January 1, 1950, to December 31, 1950.

Respectfully submitted,

JESSE H. BALDWIN.

REPORT OF THE TRUSTEES OF THE RESEARCH FUND

To the Ohio Academy of Science:

The Trustees of the Research Fund present the following report of receipts and expenditures during the past year:

RECEIPTS:

Bank balance on January 1, 1950	$224.84
Income from Investments	84.50
Interest from U. S. Bonds, etc., since January 1, 1951	36.00
	$345.34
Less bank charges	1.28
Cash Income	$344.06
1950 credit available from A. A. A. S.	270.50
Total	$614.56

EXPENDITURES:

Grant to Mrs. Ethel Miller (February 7, 1951) to help defray costs of Index to the Ohio Naturalist and the Ohio Journal of Science	$100.00	
Grant to Miss Elizabeth W. Smith, Kent State University, "Research on Endocrinology in Bats"	70.50	
Grant to the Committee on "Flora of Ohio," Dr. Lucy Braun, University of Cincinnati, Chairman	200.00	
Total		370.50
Balance April 9, 1951		$244.06

Respectfully submitted,

HERBERT OSBORN,
GEORGE B. BARBOUR,
E. N. TRANSEAU, *Chairman.*

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

The annual meeting of the Joint Administrative Board of The Ohio Journal of Science was held in Columbus, Ohio, February 24, 1951. The meeting was called to order by Dr. Spieker. Present were Drs. Spieker and Meyer, representing the Ohio State University, Drs. Tidd and Hefner, representing the Ohio Academy of Science, and Drs. Green, Blaydes, Popham, and Böhning, of the Ohio Journal of Science staff.

Dr. Spieker was re-elected to serve as Chairman of the Board. The minutes of the preceding meeting were read and approved.

The report of the Business Manager was mainly in the form of a financial statement for Volume 50, a copy of which is attached to this report. The report was accepted and placed on file.

The Board passed a resolution asking that the Council of The Ohio Academy of Science be requested to continue to pay the authors' one-half share of the cost of illustrations for papers published in The Ohio Journal of Science.

Dr. Tidd was appointed to select a person of his choosing to help him in performing the annual auditing of the Business Manager's account.

Dr. Böhning presented an informal report of the Advertising Representative of the Journal. He said that during the past year 17 companies have placed advertising in the Journal, and a number of these have contracted for space during 1951. The present emergency has made necessary a cutback in the advertising appropriations of a number of companies which had expressed interest in the Journal as an advertising medium. Every effort, however, is being made to increase the amount of space devoted to advertising. Although the cost of securing advertising is high, it has more than paid for itself and has made a sizeable contribution to the operating funds of the Journal.

The Board suggested that the Business Manager and Advertising Representative approach the Business Manager or other proper officials of The Ohio State University and request their assistance in the solicitation and procurement of advertising contracts from suppliers.

Dr. Blaydes, Editor of Volume 50, reported that 306 pages of text material had been published in Volume 50 in comparison with 252 pages for Volume 49, an increase of 21 percent. Forty-six papers representing fifteen fields of science were published in Volume 50. Comparative figures for Volume 49 are forty-one papers in thirteen fields. Thirteen book reviews and announcements were also printed. A historical sketch of The Ohio Journal of Science was also presented to the Board.

The Board directed that the historical sketch of the Journal be submitted to the Editor for publication in The Ohio Journal of Science.

The Joint Administrative Board of The Ohio Journal of Science accepted with regret the resignation of Dr. G. W. Blaydes as Editor-in-Chief, and expressed its deep appreciation for his long services on behalf of the Journal.

Dr. Green was elected Editor-in-Chief, Dr. Popham, Business Manager, and Dr. Böhning, Advertising Representative for Volume 51 of the Journal.

Dr. Green reported that the March issue of the Journal was now in page proof and that the May issue is in galley proof. The May issue is to contain an ecological symposium on the Glacial Border. In addition to these two numbers, nine manuscripts are in various stages of processing for publication. Dr. Green said that the vice-presidents of the Ohio Academy of Science sections had been informed of their functions as Associate Editors and cooperation in soliciting manuscripts in their respective fields had been invited. The recently appointed book review editor, Dr. C. M. Wilson, has many reviews in preparation which will soon begin to appear in the Journal.

Dr. Popham proposed a plan to be known as "The Ohio Journal of Science Award for Excellence in Research." After a discussion in which several suggested changes were offered, Dr. Meyer moved, seconded by Dr. Tidd: (1) that the Board is favorably inclined to the principle of the proposal, (2) that the plan as submitted be referred to Dr. Popham and Dr. Green for revision in the light of the discussion, (3) that the revised proposal be circulated to all members of the Board, (4) that Drs. Popham and Green poll the Board by mail on the revised plan, (5) that if the vote is unanimously favorable, the plan should be placed in effect at the time of the next meeting of The Ohio Academy of Science.

A drawing was held by lot to determine the field in which the awards for the year 1951–1952 will be presented. The lot chosen by Dr. Blaydes indicated the field of Chemistry.

There being no further business, the Board adjourned on a motion by Dr. Meyer, seconded by Dr. Hefner.

Respectfully submitted,

RICHARD A. POPHAM,
Secretary of the Board.

THE OHIO JOURNAL OF SCIENCE

Fiscal Year 1950

(Volume 50, Fiscal Year, January 18, 1950, to January 18, 1951)

RECEIPTS

Bank Balance, January 18, 1950	$ 198.92
Ohio State University—Paid for Subscriptions	750.00
Ohio Academy of Science—Paid for Subscriptions	1,782.00
Non-members—Paid for Subscriptions	512.32
Sale of Separate Numbers, Volumes, and Reprints	1,680.22
Authors—Paid for one-half Cost of Plates	191.14
Ohio Academy of Science—Paid for Annual Report	99.99
Miscellaneous	27.73
Advertisements	877.49
	$6,119.81

EXPENDITURES

Spahr and Glenn—Printing Journal	$3,635.46
Spahr and Glenn—Mailing Envelopes	126.72
Spahr and Glenn—Reprints	259.02
Advertising	153.62
Bucher Engraving—Plates	275.16
Postage and Express	276.55
Office Supplies and Bank Charges	86.88
Refunds	4.37
Secretary and Labor	194.84
Bank Balance, January 18, 1951	1,107.19
	$6,119.81

REPORT OF THE COMMITTEE ON CONSERVATION

The Conservation Committee expresses pleasure with the formation of the Ohio Department of Natural Resources and its appointment of qualified personnel and its effective progress to date; the Committee is also pleased with the cooperation which exists within the several divisions of the department and commends the work of the Director and the Division Chiefs.

The Conservation Committee recommends the teaching of Conservation in connection with courses, including soils and geological materials, biology, geography, general science, economics, civics, etc., in the public schools. The Committee recommends a wider use of field study in the schools.

The Conservation Committee commends the fine work of the Ohio Conservation Laboratory and believes that colleges and universities should include more field work in their curriculi.

Respectfully submitted,

E. S. THOMAS, E. L. RICE,
P. B. SEARS, R. W. DEXTER,
F. J. WRIGHT, R. W. FRANKS,
R. A. HEFNER, L. S. ROACH,
J. R. BECK, *Chairman.*

REPORT OF THE COMMITTEE ON NECROLOGY

The Necrology Committee reports with deep regret the death of eleven members of the Academy since the last annual meeting. The following memorial statements were prepared from material submitted by relatives and colleagues of the deceased members.

Respectfully submitted,

KARL VER STEEG,
RODERICK PEATTIE,
H. H. M. BOWMAN, *Chairman.*

DANIEL R. BARR

Dr. Daniel R. Barr, Physician of Grand Rapids, Ohio, member of the Medical Science Section since 1936, was born in Fostoria, Ohio, on May 15, 1886. After attending the public schools there he came to Toledo and attended the old Toledo Medical College from which he was graduated in 1911. In that year he also married Miss Ida May Powell. After receiving his M.D. degree he pursued graduate work at Harvard Medical School and the University of Michigan Medical School.

He settled in Grand Rapids, Ohio, in general practice and remained until 1915. Then he enlisted in the Red Cross and served in Europe during World War I. Upon his return to the United States he joined the Taylor Instrument Co. as Medical-Director of Research and remained in this post until 1932. He is credited with doing important research in the development of the iron-lung, and the recording sphygmomanometer.

In 1933 he returned to Grand Rapids, Ohio, and again took up his practice. He promoted the water works for his community and organized the Chamber of Commerce. He was a member of the Exchange Club, the Masonic Lodge, Scottish Rite Masons, the Presbyterian Church and the Wood County Park Board.

In Toledo he was staff member of St. Vincent's and Flower Hospitals. He also was a member of the Wood County Medical Society, the Ohio Medical Society, and the American Medical Association and, at the time of his death, was national Treasurer of the American Academy of General Practice. He died of coronary thrombosis on May 24, 1950, survived by his wife, Ida. He was buried in Beaver Creek Mausoleum at Grand Rapids, Ohio.

Albert Wesley Boetticher

Professor Albert Wesley Boetticher, Botanist at Ohio University, was elected a member of the Botany Section of the Academy in 1929. Professor Boetticher was born in Clarington, Ohio, on December 29, 1885. He received his Bachelor of Science Degree from Ohio University in 1917 and the Master of Science degree from Ohio State University in 1935. From 1905 to 1910 he taught in Ohio public schools and from 1911 to 1914 was connected with high schools in the State as a teacher and supervisor. In 1916 he became a member of the faculty at Ohio University.

Professor Boetticher's special field of interest was the ecology of forests in Southern Ohio. He served on the White Pine Survey of the U. S. Forestry Service. He was a member of the A.A.A.S., the American Association of University Professors, and was a charter member of the Association of American Taxonomists.

In 1914 he married Miss Hazel Bowen and to this marriage a son, Robert, was born. On March 4, 1951, Professor Boetticher passed away at his farm home near Athens, Ohio, of heart disease. He is survived by his wife and son. Interment was made in Clarington Cemetery, Clarington, Ohio.

Raymond Auson Dobbins

Professor Raymond Auson Dobbins, Albany College of Pharmacy, was elected a member of the Botany Section in 1921, created a Fellow in 1938, and Vice-President in 1938. Professor Dobbins was born at Kokomo, Indiana, on December 31, 1895. He received the Bachelor of Science degree at Ohio Northern University in 1917 and the Bachelor of Arts degree from Ohio State University in 1920. He was a University Scholar from 1922 to 1923 and an Instructor in Botany from 1923 to 1926. In 1922 he attained the Master of Science degree and the Ph.D. was awarded in 1937 by Ohio State University.

From 1926 to 1945 he was assistant professor at Ohio Northern and professor from 1945 to 1948. From 1948 to his death in 1951 he was Professor of Botany and Head of the Department in the Albany College of Pharmacy of Union University, Albany, N. Y. In September, 1950, he was certified as Senior Scientist in Botany for the Museums of the State of New York. From 1917 to 1919 he served his country in the U. S. Army. During the summers of 1920 to 1923 he was Field Assistant for the U. S. Department of Agriculture.

Professor Dobbins was a member of the A.A.A.S., the American Botanical Society, the Phytopathologists, and the American Ecological Society. He published papers on mosaic diseases of tomato, and ecology of Ohio vegetation.

In 1925 he married Miss Louella Phillips. They had two daughters, Esther Ellen Dobbins, now a student at Ohio State University, and Sara Low Dobbins, a student at New York State Teachers College at Albany.

Professor Dobbins died suddenly of an initial attack of coronary thrombosis on November 3, 1950. Following the cremation at Troy, N. Y., his ashes were interred at Ada, Ohio.

Robert C. Gowdy

Dr. Robert C. Gowdy, University of Cincinnati, was made a member of the Physics section in 1913 and a Fellow in 1920. Dr. Gowdy was born in Springfield, Ohio, on March 10, 1886, and received the B.A. degree from University of Cincinnati in 1906. In 1906 he was appointed a Hanna Fellow and continued in the Fellowship to receive the Master's Degree in 1907. In 1909 he won his Ph.D. in Physics. In 1947 his alma mater awarded him an honorary D.Sc., and in 1910 he had received the Honorary D.Sc. from Cambridge University, England, and also an honorary D.Sc. from the College de France in 1911. His teaching positions included an Instructorship in Physics at Lehigh University in 1911 and 1912. He was called to Cincinnati in 1936 as Professor of Physics and as Dean of the College of Engineering. From 1946 to 1951 he was emeritus Professor.

He served as a Captain in the Chemical Warfare Service of the Army in World War I from 1917 to 1919. He was a member of A.A.A.S., the American Physical Society, the Engineering Education Society, and the Physics Teachers Association. He was a specialist in the study of secondary x-rays from metals.

In 1914 he married Miss Mable Greely and to them was born one son, William P. Gowdy. Dr. Gowdy died on March 27, 1950, of heart disease and was interred in Spring Grove Cemetery in Cincinnati.

Lynds Jones

Dr. Lynds Jones, Oberlin College, was made a member of the Zoology section in 1894 and a Fellow in 1920. Dr. Jones was born at Jefferson, Ohio, on January 5, 1865. His education was secured at Grinnell College for two years, 1888–1890, and then at Oberlin College where he received his M.Sc. degree in 1895. He was a graduate Fellow at the University of Chicago in 1904–05 and received his Ph.D. degree in 1905. From 1905 to 1920 he was connected with Oberlin and for 30 years was curator of its museum. From 1920 to 1931 he was head of the Department of Zoology and Geology and from 1931 to 1951 he was Professor Emeritus. He was also Director of the Lake Laboratory of Ohio State University and Editor of the "Wilson

Bulletin" from 1892 to 1924. He was a member of the A.A.A.S., the Ornithological Union, and the American Ecological Society. He was a student of bird migration, moulting, bird skeletons, and the birds of Ohio.

In 1890 Professor Jones married Miss Clara Mabelle Tallman. Of this union four children survive: Lynds L. Jones of Baton Rouge, La., Mrs. Max W. deLaubenfels of Corvallis, Oregon, Professor George T. Jones of Oberlin College, and Professor Harold C. Jones of Greenville, North Carolina. Dr. Jones died of uremia on February 11, 1951, and after cremation his remains were interred at Oberlin, Ohio.

Ross Baker Kefauver

Mr. Ross Baker Kefauver, of Bexley High School, Columbus, Ohio, was made a member of the Chemistry Section in 1949. Mr. Kefauver was born in Stoutsville, Ohio, on April 24, 1894, and received his B.S. degree from Heidelberg College and his Master of Science degree from Ohio State University. He was a veteran of World War I and upon his return from the service became principal of the High School at Canal Winchester, Ohio, in 1919. He remained here until 1931 when he went to Bexley as a science teacher where he remained until his death. He was a member of the American Chemical Society, the National Association of Science Teachers, Masons, American Legion, and the Methodist Church.

In 1922 he married Miss Virginia Burtner and to this union were born a son, Weldon A. Kefauver, and two daughters, Lenore and Louise Kefauver, all of Columbus. Mr. Kefauver succumbed to general carcinoma on September 22, 1950, and was interred in Glen Rest Cemetery in Columbus, Ohio.

Burdette H. Lowe

Professor Burdette H. Lowe of Akron University was made a member of the Mathematics Section of the Academy in 1948. Professor Lowe was born in Polk, Ohio, on March 15, 1898. He attended Ashland College from 1915 to 1917 and Akron University in 1919–20. Then he transferred to Montana State College and received his B.Sc. degree in 1921. In 1925 he attended the University of Colorado and received the Master of Science degree. During the years 1931 and 1932 he was enrolled as a graduate student at Ohio State University. In experience he was employed as Mathematics Instructor at Montana State College from 1921 to 1928, and as Professor of Mathematics and Physics at Ashland College from 1930 to 1931. Then he was employed by the rubber industries as an accountant from 1934 to 1947 and from 1947 until his death in 1950 as Instructor in Mathematics at Akron University. Mr. Lowe had never married.

His special interests in Mathematics lay in Cubic Equations and the History of Mathematics. He was a member of the Mathematics Association of America and Pi Kappa Phi. He died on April 24, 1950, of cardiac failure and was buried at Polk, Ohio.

Jesse Mathews Robinson

Professor Jesse Mathews Robinson of Alabama Polytechnic Institute, Auburn, Alabama, was made a member of the Zoology Section in 1914. Professor Robinson was born in Higginsport, Ohio, on January 30, 1889, and received his A.B. degree from Miami University in 1911, and the M.A. from Ohio State University in 1916. He taught science in Ohio schools from 1911 to 1915 and was a principal from 1915 to 1917. In 1915–16 he was assistant in Zoology and Entomology at Ohio State University. From 1917 to 1918 he was engaged as extension worker for the U. S. Department of Agriculture in North Carolina and Tennessee. In 1919 he accepted the position as Assistant Professor of Zoology and Entomology at the Alabama Polytechnic Institute. In 1921 he became Associate Professor and in 1924 Professor and head of the Department until his death. He was a member of the A.A.A.S., Economic Entomologists, the American Entomological Society, and the American Genetics Association. His special fields of investigation were cotton insect pests, the boll weevil, red spider, boll worm control, insect pests of vegetables, and the life cycle of the banded beetle.

On August 21, 1919, he was married to Lena May Shinkle. They have no children. Professor Robinson died on August 27, 1949, of coronary thrombosis. He is interred at Felicity, Ohio.

Charles G. Rogers

Dr. Charles G. Rogers, Oberlin College, became a member of the Zoology Section of the Academy in 1913 and was made a Fellow in 1920. Dr. Rogers was born in Perry, New York, on March 4, 1875. In 1897 he received the A.B. degree from Syracuse University and the M.A. in 1899. The honorary Sc.D. was conferred upon him by his alma mater in 1920, a similar honor from the University of Chicago in 1920. He secured his Ph.D. from California in 1904. He was an instructor in Zoology at Syracuse from 1899 to 1902, an assistant professor at Chicago in 1902 and at California from 1902 to 1904. He was assistant professor at Kansas in 1904 and from 1905 to 1913 was professor at Syracuse. He then became professor and head of the department at Oberlin College, until his retirement as emeritus in 1941. During 1942–43 he was

visiting professor of Zoology at Duke University and from 1915 to 1930 was on the teaching staff at Woods Hole Biological Station. He was a member of the American Zoological Society, the American Society of Physiologists, and was a student of comparative physiology and heat production.

In 1906 he married Miss Rose Humann to which union two children were born, Mrs. Mary Rogers Nute and Martin H. Rogers. Professor Rogers died at Oberlin on October 12, 1950, of acute myocardial infection, is survived by his wife and the son and daughter, and was interred in that city.

James Jesse Turner

Dr. James Jesse Turner, Hiram College, elected to the Plant Science Section of the Academy in 1946. Dr. Turner was born in Hiram, Ohio, on August 24, 1880. He received his Ph.B. from Hiram College in 1902 and his M.Sc. in 1913. In 1923 he received the Ph.D. from the University of Chicago. In 1902–03 he taught in high schools in Ohio, in 1903–04 in Illinois, and in 1904–06 in Indiana. In 1906 he became Professor of Biology at Hiram College where he remained until his death. He was a member of the A.A.A.S. His special field of investigation was the morphology of Lycopodium.

In 1906 he married Miss Bertha Clement and to them were born four children, Robert Turner, Ralph Turner, Phillip Turner and Mary Elizabeth Turner. Dr. Turner died on April 22, 1950, of cancer and was interred at Hiram, Ohio.

Otto C. VonSchlichten

Professor Otto C. VonSchlichten, University of Cincinnati, was made a member of the Geology Section of the Academy in 1928 and advanced to Fellowship in 1929. Professor VonSchlichten was born in Cincinnati on July 19, 1886, and was graduated from the University of Cincinnati with the A.B. degree in 1911. He pursued graduate work at the University of Wisconsin during the years 1912 and 1913 and also at the University of Michigan in the summers of 1920 and 1921. In 1911 he was appointed Instructor in Geology and German in the University of Cincinnati. From 1913 to 1915 he served as geologist for the Bureau of Geology and Mines of the State of Missouri. In 1915 and 1916 he was Instructor of Geology in the University of Cincinnati. In 1916 and 1917 he was Instructor of Geology at Lehigh University and in 1917 he returned to Cincinnati as Assistant Professor of Geology in which rank he taught until 1940. At that time he was advanced to the rank of Associate Professor which position he retained to his death. Professor VonSchlichten was a member of Phi Beta Kappa, Sigma Xi, Fellow of the Mineralogical Society of America, and the A.A.A.S. and a member of Alpha Delta chapter of Sigma Gamma Epsilon. His field of study and interest was geology, especially mineralogy and petrography. He published a treatise on "Landslides in the Vicinity of Cincinnati" in the "The Compass" of March, 1935. In 1914 he married Miss Anna Erlwein and to this union were born Captain Harold C. VonSchlichten and Margaret VonS. Myers (Mrs. Eugene F. Myers). On October 4, 1950, Professor VonSchlichten suffered a fatal heart attack and was buried in the Vine Street Cemetery, Cincinnati, Ohio.

REPORT OF COMMITTEE ON RESOLUTIONS

Be it Resolved, that the members of the Ohio Academy of Science express to the faculty and administration of Miami University their appreciation of the fine facilities furnished and the hospitality so freely extended, which have made our sixtieth annual meeting so pleasant and successful.

Be it Resolved, that the members of the Academy record our appreciation to Mrs. Margaret McCartney for her services as librarian for the past year, a position from which she has recently resigned.

Be it further Resolved, that the Ohio Academy of Science record our sincere appreciation to Dr. Glenn W. Blaydes who has served as editor of the Ohio Journal of Science for ten years. Dr. Blaydes has done an excellent job of editing our Journal these difficult years, for which we, as an organization and as individuals, wish to express our gratitude. In this connection it seems desirable to record the fact that the November, 1950, issue marked the 50th anniversary of the Ohio Journal of Science, for which we wish to express our appreciation to all who have in one way or another contributed to the maintenance of this publication at its high level of scientific journalism.

Respectfully submitted,

H. R. Eggleston,
A. W. Lindsey,
W. C. Beaver, *Chairman.*

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